The Cider Makers' Hand Book

A Complete Guide For Making And Keeping Pure Cider (1896)

J. M. Trowbridge

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A COMPLETE GUIDE

FOR

Making and Keeping Pure Cider.

BY

J. M. TROWBRIDGE.

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TABLE OF CONTENTS.

LIST OF ILLUSTRATIONS.

CIDER MAKERS' HAND BOOK.

CHAPTER I.

INTRODUCTORY.

Good cider is a much greater rarity than good wine, which all will admit is scarce enough. Few Americans, indeed, have ever tasted a perfect cider. This is a strange fact, in a country so blessed as this is with an abundance of apples, and where the general intelligence and inventive genius of the people are so great, and where all the necessary mechanical appliances have been brought to such high perfection and convenience that the older nations seek after and copy them; yet, with all these advantages three-fourths, yes, probably nine-tenths, of all the cider made is utterly spoiled, either in the process of making or immediately after becoming cider, and is totally unfit for human consumption, as well as entirely unmerchantable.

The fact, for such it confessedly stands, is due more to want of general information of a plain and practical kind, based on exact scientific facts, in regard to the few and simple requirements to be observed in making and keeping cider, than to any other cause. No hand book of plain practical instruction on the art has been published in many years.

For all purposes for which wine is commonly used, cider, properly made, has much to commend it over

many wines. The principal difference between them lies in the lighter alcoholic strength of cider and in the absence therefrom of tartaric acid, which is the principal acid of wine. Tartaric acid combines with lime to form precipitates, or insoluble particles, whenever they are brought into contact. Now, as nearly all food contains lime, such contact occurs nearly always when wine is drank, especially if it be tart wine. The precipitates thus formed are not always carried off through natural channels, and it is to this cause that certain disorders prevalent among wine-drinkers, such as gout, articular-rheumatism, and kidney difficulties, have been attributed. Cider is certainly free from this objection, since it contains no tartaric acid, the place of which is supplied in the apple by malic acid. The latter acid is also found in grape juice, with tartaric, but it has not the power to form precipitates with lime like the tartaric. Malic acid is the principal acid in cranberries, rhubarb, cherries, and also a component of a large number of the most wholesome fruits and plants.

Besides this difference of kinds and qualities of the natural acids, cider differs very greatly from wines in alcoholic strength, having generally only about half the average of wines. Nine to ten per cent is an average of the strength of "non-fortified" wines (wines to which no distilled spirit has been added), while four to five per cent is an average of the strength of cider. These per cents are for absolute alcohol or double brandy.

From these statements it will be seen that, in drinking equal quantities of wine or cider, the cider-drinker will have taken only half the alcohol, and that with acids which are perfectly wholesome, while the wine-drinker, with his double proportion of alcohol, drinks also an acid which may lead to serious physical ailments.

So much by way of comparing the relative merits of cider and wine, as to wholesomeness. But it is by no

means to be understood from this that either of these beverages, when pure, well made, and not used to excess, is ever harmful. The acids seem to meet a demand of nature prevailing in all warm climates, while at the same time they appear to have power to so modify and ameliorate the effects of the very moderate proportion of alcohol present as to deprive it of the power to harm which it has when separated from them by distillation. A distinguished medical writer says: "The alcohol naturally in wine is so blended with its other constituents as to be in a modified state, which renders it less intoxicating and less injurious than the same quantity of alcohol separated by distillation and diluted to the same degree with water."

In harmony with this is the claim put forward by many who have given the subject most study and thorough research (and that, too, from purely philanthropic motives), that "wine-drinking nations are temperate nations." Among the eminent men who may be named as acting on this belief from purely philanthropic motives was the late Nicholas Longworth, of Cincinnati, Ohio. His conviction was that the craving for stimulant, universal, in some form, among mankind, could be satisfied most naturally and least harmfully now, as it was in the time of the prophets, by the use of light wines. It was for this reason that he introduced and promoted vine culture in Ohio, and became, in fact, the founder of the vine-growing industry of the Atlantic States. It is said to be for the same reason that Senator Stanford, of California, has planted the largest vineyard in the world. Both these gentlemen's motives are beyond possibility of misconstruction, since Mr. Longworth was, and Mr. Stanford is, possessed of vast wealth, so great, indeed, as to render cares of this nature a labor to be undertaken from a sense of duty only.

The writer may add that his early instructor in the

art of cider-making was a physician of acknowledged skill and high standing in Central New York, where no grapes were then grown, but an abundance of the finest apples. He carried the art of cider-making to great perfection, and instructed the community about him freely and fully in the process. He also commended the use of cider professionally to his patients. Afterward he removed to a large city in the interior of the State, where he continued his medical practice. Here he was kept too busily employed in his profession to devote much time to cider-making. He lived, in active practice of his profession, to the age of 81 years, maintaining to the last his good opinion of cider, and using it himself in his last illness. He often made the remark, that few men lived to the age of fifty without experiencing some ailment of the urinary organs, from which he was himself a sufferer, and he regarded pure cider as a very great preventive and remedial agent for such troubles.

Doubtless there are many other physicians of the same opinion, and there would be still many more, were a well-made article of sound, pure cider always obtainable. As it is now, scarcely any physician knows what a pure, well-made cider—a true apple-wine—is like. Certainly they may justly be excused from venturing to recommend to any patient the use of such as is usually sold by grocers and saloons.

The writer has found, by oft-repeated trials, that it is the most difficult of all articles to obtain in saloons, restaurants, and groceries. All keep an article they sell for cider; but in many cases it has but a small portion of fermented apple-juice, while in others there is *no trace of the apple,* the stuff sold being a villainous compound of vinegar, glucose, whisky, and pepper. Now it is perfectly patent that such a concoction could never be sold in this country for cider, any more than it could be sold in France for wine, if the knowledge of the true arti-

cle prevailed here as does that of true wines in that country. But before such knowledge can prevail here, the cider makers must learn how to make cider correctly. There is where the fault lies, and the consumers will learn their part fast enough when a fairly good article is offered for their acceptance.

It is to instruct cider makers that these pages have been written. The instructions given, when followed faithfully and intelligently, will produce a perfectly pure and wholesome beverage, and the writer desires, at the outset, to call attention to the fact that all the processes hereinafter described tend directly to one purpose only, and that is the constant purifying and refining of cider. Neither nostrums, drugs, nor chemicals are used or recommended. Whoever looks over these pages with the expectation of finding any practice of that kind recommended will be disappointed. All the processes here advised are the latest, most approved, and best now in use among intelligent wine makers for making pure white wines. Cider should be nothing more nor less than a true apple-wine; that, and nothing else. But, like grape-wine, it may be well or ill made, and it may be agreeable or disagreeable, and yet be pure. It is the intent of these pages to show how to make cider both pure and agreeable.

CHAPTER II.

THE PROPERTIES OF CIDER.

A pure article of cider, skillfully made from select fruit in perfect condition, should have perfect limpidity and brightness, even to sparkling in the glass; it may vary in color from a delicate straw to a rich amber color, more or less deep, but should never be a bright red, nor, indeed, show much of a roseate tinge. It should be fragrant, so that when a bottle is freshly opened and poured into glasses an agreeable, fruity perfume will arise and diffuse itself through the apartment, "with a benison on the giver." It should be tart, like Rhine wine, and by no means sharp or harsh. It should have a pleasant, fruity flavor, with aromatic and vinous blending, as if the fruit had been packed in flowers and spices. It should have mild pungency, and feel warming and grateful to the stomach, the glow diffusing itself gradually and agreeably throughout the whole system, and communicating itself to the spirits. It should have a light body or substance about like milk, with the same softness and smoothness, and it should leave in the mouth an abiding agreeable flavor of some considerable duration, as of rare fruits and flowers.

These qualities are all attainable, but they demand the knowledge and skill which come by practice, thought, assiduous painstaking care, and, above all else, the most rigorous cleanliness. With these, and proper material, any intelligent person can make good cider. There is no mystery about it and no secret.

DEFINITIONS OF TERMS.

Before entering upon a description of the materials, apparatus, and processes of cider-making, it will be best

to state exactly what is meant by the terms we shall employ. With these clearly defined at the outset, we shall be better understood, and have no need to digress, in the body of the text, for that purpose.

ALBUMEN is a substance which exists in very small proportions, though of great importance as respects cider- and wine-making, in all fruit and vegetable juices. It also exists more abundantly in animal substances, as in milk, blood, and the white of eggs, which last is nearly pure albumen. The kinds are called animal or vegetable albumen, according to their origin. Their properties are nearly identical; they are all coagulated and rendered insoluble in water, by heat, as is seen in boiling eggs, in scalding milk, and in cooking meats. They are also coagulated by tannin. Before coagulation, albumen is very prone to decay, and quickly excite fermentation (which is the initiative of decay) in fluids in which they are dissolved. Albumen is a component of yeast, or ferment.

ALCOHOL is the spirit produced by vinous fermentation of fruit juices, and of other liquids containing saccharine or starchy substances. Wherever used in the following pages it means *absolute* alcohol, that is, alcohol without water, called by chemists anhydrous alcohol.

Absolute alcohol is something rarely seen, even by chemists, since it is not only very difficult to produce, but is also extremely difficult to keep, as with the least exposure it takes moisture from the air, and so becomes diluted. Still, for the sake of exactness, in speaking of alcohol the term must be understood to mean, as it does in chemistry, alcohol without water. Such alcohol is rated at 100%; that usually found in drug stores is from 85 to 96 parts absolute alcohol, and from 15 parts to 4 parts water; hence is called 85% and 96%. Whisky, brandy, rum, and gin, when of full strength, are called

"proof," and have equal weights of alcohol and of water, consequently are 50% alcohol.

Acid is the sour portion in fruits and other substances. All acids obtained from fruits and plants are called *organic,* while those obtained from mineral sources, as oil of vitriol (sulphuric acid) and aqua fortis (nitric acid), are called *inorganic* acids.

The organic acids are constituents of fruit juices, and, next to saccharines, exert the most powerful influence on the quality of the cider or wine made from them. Usually there are several kinds of inorganic acids existing at the same time in all fruits, and there are others, produced by fermentation, which do not exist in the original juice. Succinic acid is so produced, also carbonic acid, pectic, acetic, and perhaps some gallic acid.

When acids are brought into contact with alkalies, the two enter into combination, and are greatly changed. Both acid and alkali lose their distinctive characteristics and go to form a new substance unlike either of the originals. They are then combined, and each is neutralized. The acid loses much or all of its sourness, and the alkali a part or all of its bitterness. Sometimes both the sourness and bitterness altogether disappear.

The acids of fruits are usually combined with, and in part neutralized by, potash, and sometimes with a little lime and magnesia. The small portion which remains uncombined is called *free acid.* It is to this portion of free acid—sometimes rather excessive—that the sharp flavor of tart fruits and plants is due, as in the lemon and rhubarb.

When acids and alcohol are brought into contact, as they are in wines and cider, the alcohol is in part changed to *ether;* and each acid has its own peculiar ether, imparting a special odor or fragrance. The amount of ether so produced is very minute, but as it is sharply pungent it becomes keenly perceptible to the

senses. Besides this indirect effect by their ethers, the several acids have each a special flavor or taste by themselves, and by which they may be known.

The principal acid of the apple is the *malic,* named from the Latin word *malum,* an apple. The same acid prevails, also, as has been mentioned, in the cranberry, rhubarb, and many other fruits besides the apple, all of which are regarded as wholesome.

The acid of the grape is principally the *tartaric,* that of the lemon and orange is *citric,* and nearly all fruits contain both *tannic* and *phosphoric* acids, in addition to their principal one, and perhaps others. It is to the combined flavors and odors produced by these acids and their ethers that cider and wine mainly owe their flavor and fragrance, or bouquet.

Acetic acid is the acid of vinegar. It is not a natural acid, but is always produced from alcohol, and never exists in apples or other fruits or their juices until they begin to decay. Its well-known smell, however faint, whether about a cider-mill, barrels, utensils, or the premises where cider is made or stored, is to be accepted as a sign of danger, requiring instant and energetic preventive measures.

An apple with insufficient acid is usually flavorless and insipid, and yields a cider of like character; but such fruits have their uses, as hereinafter explained. On the other hand, an apple may have a very large, even an excessive proportion of acids, and still not be too tart to be agreeable to eat, and not unsuited for making good cider. In such cases the acid is not *free,* but is combined with, and neutralized by, potash, so that it is not perceptible to the taste.

Acetification is the change of alcohol into vinegar (acetic acid) by oxidation. It is the usual course of destruction of cider and wine, and, unless prevented, follows immediately after the vinous fermentation, and

sometimes, though rarely, it goes on simultaneously. It is much easier to prevent than to stop after it has once begun. It can not occur without access of oxygen, nor without a certain degree of warmth, nor when the alcoholic strength is too high. All these conditions must concur together; that is, the alcoholic strength must be low enough, the warmth must be high enough, and there must be free oxygen present. Unfortunately, all these conditions occur together readily and too frequently with cider. The alcohol is never too high, the warmth necessary is so low as to be rather difficult to prevent, and the access of air, which is one-fifth free oxygen, is almost impossible to exclude. Hence the ease with which cider runs into the acetous fermentation.

Wine above 12% alcohol will not acetify, under ordinary circumstances, nor will acetification *begin* at a temperature below 48° F., but once commenced it will continue to progress down to 42° F., where it ceases. Cider or wine put into glass and hermetically sealed can obtain no oxygen, and hence can not acetify. Cider in barrels will receive oxygen from the air through the pores of the wood and around the bung, and thus acetify, unless prevented by suitable measures.

These facts explain the necessity of excluding air as much as possible in all manipulations of cider.

Acetification of cider and wine manifests itself to the sight before it does to the taste or smell. The surface of the liquid where the action has commenced is covered with a white, powdery substance, apparently as though it had been dusted with flour. It is called "flowers of wine" by the French. If the wine or cider is then instantly treated, as hereinafter directed, it may be saved.

ALKALI. Certain substances which have the power of combining with acids and neutralizing them, or seemingly destroying them, causing their disappearance to

the taste, are called alkalies. Most common among them are lime. potash, soda. magnesia, and ammonia. Potash and lime are component elements of nearly all land plants, their fruits and juices. Soda is less abundant, except in salt-water plants, and ammonia is a gas, though when combined with acids it becomes a solid. (See Acids.) The familiar character of these substances needs no further description.

ANTISEPTICS are those substances which have power to prevent or arrest decay, and consequently like power over fermentation. Salt is the most familiar example. Smoke used in curing provisions is another. The list of these substances is a long one. Very few indeed are admissible in cider- or wine-making, and none are necessary, now that better means have been devised for accomplishing the same results for which they have been used. The best, and, in fact, the only antiseptic which can be used in cider, when it is not practicable to apply the better means, is Sulphurizing.

ASTRINGENCY. That quality in some fruits, as well as other substances, which puckers the linings of the mouth, the tongue, and lips. It is very marked in the wood and bark of the oak, in the seeds and stems of grapes, and in many unripe fruits, as the persimmon, the crab-apple, the plum, and others. It is known to every child as the taste of alum. Astringency in fruits is attributed to excess of tannic acid.

AROMA. A word much used by the French in describing wine and cider. With them the word has a technical meaning precisely the opposite of the sense in which it is used among English-speaking nations. With us it is an agreeable smell, with them it is a disagreeble odor. Translating from the "Manuel de l'Amelioration des Vins": "Aroma. Earthy taste, more or less disagreeable, which persists after the liquid is drank. It is due to bad varieties, bad exposure (of vineyard), bad manner

of making and growing the vine, bad mode of culture, and abundance of (strong) manure." The word is used herein as by the French.

BOUQUET (translated). "Agreeable odor which exhales from wine put in contact with the air. It is the contrary of aroma. Bouquet has much analogy with (sève) flavor." The word sève, literally translated, means sap, but it is used throughout French works on wines in the sense of flavor. We can not well speak of the sap of a wine.

CIDER. The vinous liquor produced by fermentation of the juice of apples, before acetous or vinegar fermentation has succeeded.

CELLULAR TISSUE. That substance in fruits and vegetables which contains the juices. When an apple is peeled, cored, and sliced, the slices still retain the juices. If a slice is looked at through a strong magnifying glass there will be seen a great number of minute sacs or bags, called cells, adhering together, each filled with juice. If the slice is then crushed, the sacs or cells will burst, and then the juices will flow out. By repeated crushing, draining, and washing, nearly all the juice will be expelled; the substance then remaining is cellular tissue, and is nearly identical with fiber in composition, though not so in condition. All vegetable fiber can be reduced to sugar, by action of strong acids. Cellular tissue is reduced by action of the organic acids.

CLARIFIERS. Materials used to clarify cider, wines, and liquors, by removal of the insoluble particles suspended therein. They are for the most part albuminous substances of animal origin, such as eggs, milk, blood, and isinglass or gelatine. The latter, though not albuminous, is composed of the same elements, and acts in the same way as the albuminous. They act by combining with tannin into an insoluble precipitate. All these substances are very prone to decay, and are therefore

likely to be injurious to the keeping qualities of cider and wines in which any portion of such clarifiers remains uncombined with tannin. When used in excess, that is, when more of these substances are put into the cider than there is tannin present to precipitate, the surplus remains dissolved and quickly carries the liquid to putrefaction.

Special sands and clays are also used in cider for the same purposes. They are never used in wines, so far as known to the author. They act in a mechanical way, but, unfortunately, they are rarely free from noxious chemical properties. They are composed of a more or less miscellaneous mixture of earthy materials, among which there is almost sure to be some which are soluble in the free acids of cider. If any are soluble a change in taste is inevitable, and the much dreaded *gout de terroir* (earthy taste) of the wine-makers will be certain to appear.

Again, all sands and clays which are *not perfectly* white, be they brown, yellow, red, or gray, owe their color to metallic oxides, generally iron, but sometimes a more dangerous one. Iron is not dangerous, but it will injure both flavor and color.

A better method of clarifying is now used, which removes the suspended impurities at once, without the delay for settling, and which has the inestimable advantage of putting nothing into the cider or wine. (See chapter on Cleansing of Juice and Cider.)

COMBINATION is the union of two or more substances into one, differing in properties, and perhaps in form and appearance, from either of the originals. The union of acids and alkalies into neutral substances is familiar. It is necessary to distinguish between combination and mixture. Take, for instance, a mixture of two gases, oxygen and hydrogen. They will remain a simple mixture and uncombined a long time; touch the mixture

with a flame or with an electric spark, and the mixed gases instantly combine with a loud explosion and a change of form. They are no longer gases, but instead have become a few drops of water, which it is not easy to separate into the gases again. Tannin, which exists in all fruit juices, combines with gelatine and albumen, on which account they are used to clarify cider and wine. Many soluble substances, when brought into contact in solution, combine and become insoluble. Tannin acts in this way with gelatine and albumen.

Dry is a word much used in connection with wines, where it means precisely the same as the word "hard" does when applied to cider. Dry wine and hard cider are in like condition; both have been fermented until they have lost all their saccharine and have become tart, without having become, in the least degree, vinegary.

Wine just barely touched by the taste of vinegar is said to be *piqued*. The same term may be used with cider.

Defecation is the removal of suspended matters from any fluid, whether by filtration or otherwise. It is a term much used in connection with the clarification of cane-juice to make sugar.

Ebullition. The motion to be seen in water and other fluids when boiling. It is due to the formation of steam at the bottom of the vessel, which, rising to the surface, puts the whole bulk in motion.

Effervescence is ebullition produced without heat by the liberation of gas within a liquid. The gas may come from the combination of two substances, as with soda powders; or from the sudden release from pressure, by which it was held in solution, as in sparkling cider and wine, and in springs.

Ethers are liquids produced by the action of acids

upon alcohol when they are in contact. They are usually very fluid, highly inflammable, and exceedingly fragrant or odorous. As each acid has its special ether there are several kinds in cider and wine, though the aggregate of all is so extremely minute as to defy separate analysis. Yet they produce a most profound effect on wine, largely influencing its value, by the bouquet they impart. They are easily expelled by warmth, and even by exposure, as is often seen in the loss of quality by wines left open to the air a brief period.

EXTRACTIVE. The gummy matter remaining after cider, wine, or other vinous fermented beverage has been evaporated to dryness. Such matter contains also the sugar (if any remains), acids, and glycerine, which were contained in the liquid. When these are removed the extractive matter remains. In cider the extractive glycerine and acids together amount to about 1½ per cent. Extractives contribute to the body and smoothness of cider.

FERMENTATION. The seemingly spontaneous change or action which takes place in fruit juices; also that which is induced by action of yeast in saccharine and starchy liquids, during which they give off carbonic acid (gas) and acquire alcohol. There are several kinds of fermentation, but that one producing alcohol, known as the vinous fermentation, is the kind referred to in this book.

Vinous fermentation occurs only in saccharine liquids, or liquids containing substances changeable by ferment or acids into saccharine, such as starch, dextrine, etc. The amount of alcohol produced is always in exact proportion to the amount of saccharines fermented. Pasteur, to whom we are indebted for the complete mastery of the course of vinous fermentation, determined also, with the greatest precision yet attained, the exact pro-

portions of the several products resulting therefrom. He found that 100 pounds of fruit sugar (equal parts of glucose and luvulose) gave,

Alcohol,	48.55
Carbonic acid,	46.95
Glycerine,	3.00
Succinic acid,	0.64
Ferment matter,	0.95
	100.09

Cane sugar is invariably changed to fruit sugar under action of organic acid or of ferment before fermenting. Such change is accompanied by an increase of quantity amounting to 5¼ per cent, which increase is water taken into combination.

FERMENT. Yeast and ferment are terms often used to mean the same thing. Yeast, however, contains much besides ferment, and is a microscopic plant so minute that an individual specimen is invisible to the naked eye. The germs are contained in the atmosphere everywhere. They adhere to moist or gummy surfaces, such as fruits, and when they find proper conditions of moisture, warmth, and food, or media, they grow, reproduce, and die like other plants. In doing so they liberate from the sugar, in the liquids in which they exist, the elements which make carbonic acid (gas), leaving the remainder, which is alcohol.

When, in this way, alcohol has accumulated to the amount of 15 or 16 per cent in a fermenting fluid, the ferment ceases then to produce further effect; and no more than that amount of alcohol can be produced in any fluid by fermentation. Neither can fermentation be induced in any liquid containing 16% of alcohol. If a wine or other spirituous beverage is found to contain over 16% alcohol, it is certain that distilled spirit has been added to it.

The ferment in fruit juices comes from the surface of

the fruit, and is not contained in the juices themselves until mingled therein by crushing, whereby it is washed in.

Ferment is devitalized (killed) by antiseptics, and by heat at 160° F., which coagulates the albumen, one of its components. Cold simply paralyzes it, to be restored to activity with returning warmth.

FININGS. Another name for Clarifiers, which see.

FORTIFYING. To fortify cider or wine is to add distilled spirit. It is done to those which are thought to be too weak to keep, in order to give them the strength necessary to resist spontaneous change. For such purposes the only spirit that it is allowable to use is that which has been distilled from the like kind; that is, cider brandy for cider, and grape brandy for wine. Grain spirit is unfit for such use, although by similitude it might be allowed in beer.

FLAVOR. The taste imparted by cider, wine, perry, or any beverage taken into the mouth and swallowed. The entire flavor can not be obtained without swallowing a part, since a part of every flavor is felt only in the throat.

GLYCERINE. A sweet syrupy liquid, produced in cider, wine, and beer by fermentation of saccharines. It is also a component of all fats and fatty oils. All the sweetness in perfectly hard cider or perfectly dry wine is due to glycerine. The amount contained in these liquids Pasteur ascertained to be 3% of the *saccharine* fermented, which is about one-sixteenth of the alcohol produced at the same time. Glycerine, besides sweetness, also assists in giving body and smoothness, and acts also as an antiseptic or preservative.

HARDNESS. Hard cider is like dry wine, as to condition. In such cider all the sweets have been converted

to alcohol, leaving the acids naked or unmasked. (See "Dry.")

JUICE. The liquid part of fruits or plants, when expressed, and before fermentation. It contains water, saccharine, acids, extractive, potash and other substances. If all the soluble parts of apples could be expressed it would amount to more than nine-tenths of the weight of apples. As it is now, the best apparatus only obtains about six-tenths, thus leaving 33% of the juice in the pomace. Apple juice contains, on the average, only half as much saccharine as grape juice.

MUST. Unfermented juice of the grape.

MARK. The solid residue of grapes after the must has been expressed. It consists mainly of cellular tissue, skins, and seeds.

NEUTRALIZE. To neutralize a beverage is to deprive it of its usual taste or smell or of a special disagreeable taste or smell. Acids and alkalies neutralize each other. Distilled liquors are neutralized when they have been deprived of their natural taste without imparting any other.

PASTEURIZING. A method of checking and of preventing fermentation in wine, perfected by M. Pasteur, the eminent French scientist. (See chapter on Pasteurizing.)

PERRY. Fermented juice of the pear, sometimes called pear cider.

POMACE. The solid residue of apples which have been ground or crushed and from which the juice has been expressed. It consists of skins, seeds, cellular tissue, and some juice. It amounts to 30% and upward of the weight of the apples, from which it remains.

PARENCHYMA. The solid part of fruits and plants,

exclusive of skins, seeds, and fiber. It is mainly cellular tissue.

PECTIN is a substance often seen in the form of a thick, gummy coating on baked apples. It is derived from another substance in the apple known as pectose, said to be insoluble; but this is a mistake, since apple jelly, which is made from filtered juice, could not be made if this were not contained in it. It is supposed to constitute a large share of the extractives. Pectic acid is the same substance, in another form, in which it has power to make jellies. It must therefore be more abundant in green than in ripe fruits, since they make jelly much more readily than when ripe. It is conjectured to be closely allied with tannin, since that is also more abundant in unripe fruit.

SACCHARINE. Sugary qualities. The term is used in this book to denote all the substances within fruits which can be converted into alcohol by fermentation. Starch and gum are among them, but are changed first into sugar before being fermented into alcohol.

SACCHAROMETER. An instrument for ascertaining the proportion of sugar dissolved in a syrup. It is applied to apple juice, grape must, and beer wort, in advance of fermentation, to ascertain their saccharine strength, in order to know whether they are rich enough to make a satisfactory product. It is applied frequently to liquors while undergoing fermentation, in order to keep track of the progress, and see that it moves along steadily and suffers no check. It is applied at and after the termination of fermentation, to ascertain whether it has closed properly by conversion of all the sugar, or whether it needs to be promoted and continued; and it is used to determine the proper moment for bringing an over-active fermentation to an end, lest it go too far.

It will thus be seen that it is of the highest importance to the cider-maker, as well as to wine- and beer-makers.

It is, indeed, indispensable, even for the smallest operations, since good work will be done only by accident without it, and there is scarcely a chance of success, therefore. It is quite as necessary to the brewer as is the compass to the mariner. Fortunately it costs but little, is simple in construction and use, and can be sent anywhere by mail, so that none need be without it.

The principle of its construction may be illustrated in this way: Take a small piece of any light wood, like pine or poplar, about a quarter of an inch square and ten inches long. Wrap a bit of sheet-lead around one end, sufficient in weight to sink it nearly, but not quite, to the top in pure water. Then, while it floats therein, make a mark on it exactly where the surface crosses it. Put there the zero mark, 0.

Now take equal weights of pure white sugar and of pure water, and dissolve the sugar therein. When completely dissolved and commingled, by shaking or otherwise, so as to be perfectly uniform, float the stick therein. It will not sink so deep as in the pure water, but will stand much higher above the surface of the syrup than it did above the water. Put another mark at the new surface line. It will be some distance from the other. Now we know that this last fluid, the syrup, contains equal weights of sugar and water; it is therefore 50% sugar. Therefore, mark the new line 50°, and then divide the space between the marks into 50 equal spaces, and number them from 0 at pure water to 50°. We shall then have a saccharometer which will tell the percentage of sugar in any pure syrup up to 50%.

To test it, take equal *weights* (not measures) of the 50% syrup and of pure water, mingle them thoroughly, and apply the saccharometer. It will sink to the 25° mark and float there.

Now all these markings must be done while the temperature is the same, because liquids as well as solids

expand by heat—that is, become less dense, and contract by cold—becoming more dense, so that temperature must be taken into account.

A wooden saccharometer would quickly become water-soaked and lose its accuracy. Such instruments are, therefore, made of glass by the instrument-makers, with the markings or divisions on paper inside. Fig. 1. As prepared by them, the instrument consists of a thin glass tube, from eight to twelve inches long by a quarter or a third of an inch diameter. At one end is a glass ball filled with shot or mercury, and immediately above that is a bulb or air space, not unlike a fish's swimming-bladder, to keep the stem or spindle upright. The stem above contains a strip of paper made fast, divided and marked from 0, near the top, down to 50, near the bulb. Both ends are sealed, so that nothing can get inside. The divisions are all accurately made at 60° F., and the instrument, being closed, remains correct. There are many kinds of these instruments, made for different purposes, some giving specific gravity, and others arbitrary divisions, from all of which calculations have to be made to determine the amount of sugar present. It is best to get the kind made as above described, from which the solids dissolved in a fluid are read off directly without computation. This kind has been made for the author for some years, and is found most satisfactory.

FIG. 1.

Each one is accompanied by a card, giving the addition to or deduction from a reading for the difference of temperature from 60° F. Those differences are as follows:

At 66½° F. add ¼° to the saccharometer reading.
" 73½° F. " ½° " " "
" 80° F. " ¾° " " "
" 86½° F. " 1° " " "

At 51¼° F. deduct ¼° from the saccharometer reading.
" 42¾° F. " ½° " " "
" 34¼° F. " ¾° " " "

STANDARD SOLUTION. A standard solution is simply a solution of an exactly weighed quantity of a certain material, like soda, potash, or magnesia, made in an exactly weighed or measured quantity of pure water. For convenience they are so proportioned that each ten drops, or hundred drops (called minims) shall contain precisely the quantity of the dissolved material, which will be necessary to exactly neutralize a certain amount of acid in another liquid.

For example, suppose we had a standard solution of carbonate of soda, so proportioned that one fluid ounce would exactly neutralize eleven grains of malic acid. Now, if we had a gill measure (4 fluid ounces) of clean juice, and found by trial that it took exactly an ounce of our standard solution to neutralize it perfectly, and no more, we would know then that the gill of juice contained exactly eleven grains of free malic acid. Now, eleven grains per gill is almost precisely six-tenths of 1%, which may be considered standard for acidity. If it took more than that, say an ounce and a half, the percentage of acid would be 0.90%; or if it required less, and only used two-thirds of the ounce of standard solution to neutralize the gill, then the acidity would be only 0.45. Thus, it is very easy to ascertain in advance the quality of cider (as to hardness) that any juice will make when fermented, dry or hard.

It is best to buy standard solution ready prepared, because, though simple enough to make, it requires pure soda and tartaric acid (instead of malic), each accurately weighed and dissolved in pure water, exactly measured; requirements which ordinarily are not readily found where tests of this kind are to be made. It can be made by any village druggist, who will be under the necessity,

however, of using tartaric acid in place of malic, which is not an ordinary drug-store chemical. A couple of gallons (256 ounces) in a well-corked stone jug should not cost to exceed fifty cents, and will last for one season. It should be of such strength that one fluid ounce will exactly neutralize eleven grains of tartaric acid dissolved in one gill of water. That will prove an acidity of six-tenths of 1%, usually written 0.60%. It must be kept carefully corked, to prevent becoming concentrated by evaporation.

The method of using standard solution is to pour into a graduate, usually two fluid ounces. In another glass jar or pint bowl place an exactly measured gill (4 ounces) of the juice to be tested. Into this gradually pour the standard solution, a little at a time, stirring it gently but thoroughly, until effervescence ceases. Then apply a slip of test paper; if it turns red the acid is not yet neutralized, and more standard solution must be added. After which, when the effervescence has subsided, a new slip of test paper must be applied. When the test paper no longer reddens, the test is completed, *provided the paper does not turn blue.* If this occurs it shows that too much solution has been used, the juice must be thrown away, and the test commenced over with a new measure of juice.

When the juice has been exactly neutralized the amount of solution remaining from the two ounces with which the test was begun, deducted from that quantity, shows the amount used in the test. If that is one ounce the acidity is 0.60, if more, or less, it is proportional to the part of an ounce more or less than an ounce which has been used, as hereinafter explained.

SULPHURIZING is the process by which the antiseptic, *sulphurous acid*, is introduced into cider and wine, in order to check or to prevent fermentation. It is necessary to remember that *sulphurous* is not the same as *sul-*

phuric acid. They differ very materially. The former is a gas, the latter a fluid, and poisonous.

Sulphurizing is done by burning sulphur in barrels and tanks in which cider or juice is to be kept. A common and very bad way to do it is by setting fire to a strip of rag which has been dipped in melted sulphur, and holding it, while attached to a wire, in a barrel while it burns. By this method the sulphur in part melts and drops down into the barrel, imparting a disagreeable flavor to whatever is afterward put into it. The burning rag also contributes to the same unpleasant result. The best way is to employ a fumigator. This is a very simple little affair, which can be made anywhere. It consists of a sheet-iron tube six inches long, an inch and a quarter in diameter, closed at one end, and the sides punched full of small holes the size of a pencil-lead. It should be riveted together, and suspended by three wires to a long tapering bung. A live coal dropped into this, followed by a tablespoonful of sulphur or brimstone, and hung in the barrel, will give off, in burning, sufficient sulphurous acid for one sulphurizing. The barrel should have been previously rinsed with cool water and drained. The gas will then condense on the sides and impregnate the cider which is put in immediately after.

Sulphurizing has been used in this way from time immemorial, by all nations. Undoubtedly it is harmless and safe, but it is not the best way to prevent fermentation. It adds something to the cider which does not belong to it, and which, though not distinctly perceptible to the taste, nevertheless contributes toward masking and suppressing the delicate qualities and the "finesse" which constitute high character in such beverages. Pasteurizing is far more effective and preferable.

Sulphurizing of barrels to be stored away empty is an excellent means of preventing souring and mustiness.

They should be bunged up, to retain the gas. If to be used afterward for fermentation they should be rinsed thoroughly once or twice before filling, to remove the sulphurous acid, which would otherwise retard or prevent fermentation.

FIG. 2.

THERMOMETER. Everybody knows what this instrument is, in the ordinary form, and its uses. But the ordinary thermometer is not suited to use in liquids. The instrument made for this purpose, instead of being attached to a metal plate divided into degrees, is wholly of glass, and inside of a larger glass tube which causes it to float. (Fig. 2.) It also protects it from becoming foul by accumulation of fruit juice. They are usually divided according to Fahrenheit scale, and the readings are written with an F.; thus, 60° F. means 60 degrees Fahrenheit scale. That degree is considered mean temperature, and is that at which scientific instruments are graduated. The thermometer is indispensable in cider- and wine-making.

TEST-PAPER. Paper prepared to determine whether acids or alkalies, or neither, predominates in a liquid. It is simply unsized white blotting-paper dipped into the juice of the *purple* cabbage leaf and dried. It is then cut into strips a quarter of an inch wide by two inches long. One of these strips, being dipped half or a third its length in a liquid in which acid dominates, will turn red. If alkalies prevail it will turn blue. If neither, it will not alter in color, but will only appear darker from being wet. In the last case it will resume its original purple when dry. A strip can be used but once. Test paper is to be obtained at all drug stores, but sometimes those on sale are of two kinds, one for acids and another for alkalies.

FIG. 3.

TEST-GLASS. A high, narrow glass, used to contain

juice or cider while trying it with the saccharometer and thermometer. It is usually eight or ten inches high, about two inches in diameter, of rather thick glass, with a broad foot to stand safely, and a nose or lip to pour out contents.

VINOUS. Having wine-like or spirit-like taste or smell. Not merely alcoholic, but more like wine.

VINOSITY. The state or quality of being vinous.

WINE. Fermented juice of the grape; unfermented juice of the grape is *not* wine, but "must."

CHAPTER III.

APPLE JUICE.

For cider-making purposes the apple may be considered as a fruit consisting of solid substance or parenchyma not soluble, and of juice, which is water holding in solution saccharines, organic acids, extractives, and a little potash, lime, and phosphorus. After being expressed the juice contains also another material, very important in cider-making, though so minute in quantity as to be imperceptible to the naked eye. It exists on the surface of the fruit, or it may be obtained from the air in the process of grinding and pressing. That substance is ferment, upon which the change from natural juice to cider depends.

It is upon the varying proportions to each other of these materials in their juices that the relative qualities and value of apples for cider-making depend. If the saccharines are in high proportion, the cider will be strong; if low, it will be weak, because all alcoholic

strength comes from saccharines alone. If the free acids are in excess the cider will be high-flavored, but excessively hard; if they are deficient, while the combined acids are present in due proportion, the flavor will be less pronounced and without hardness; if both are deficient the cider will be flavorless, flat, and insipid. If the extractives are insufficient the cider will lack body, and will be as though watered; if in excess it will be thick and ropy. Of course one, two, or all of these conditions may exist at the same time in one and the same juice, and result in a cider strong, high-flavored, and rich, or weak, insipid, and thin, or in any of the several shades and qualities between those extremes.

It is therefore highly important in cider-making that we should know something of the qualities of the numerous varieties of apples used for that purpose. If we had such knowledge, complete, of the different varieties, we should be able to do as is done with grapes—that is, so to mix the different varieties that the juice would make a cider much more perfect than can be obtained by the use of any one variety alone. Especially would it be better than the miscellaneous and uncertain mixture of varieties which now go to make the cider of the markets, which undoubtedly contains much juice of apples that is injurious to the cider, and which would be far the better if omitted.

Unfortunately, the apple has not received such attention, in the way of analytical investigation, as has been given to the grape. There are comparatively few analyses to be found in the literature on the subject, and such as there are have little practical value for the purpose in view, owing to the confusion of names and the impossibility of identifying varieties, under the divers names which they carry in different countries, as well as in the different localities. In a French book on cider-making, now before the writer, is a list of 144 varieties of apples

grown in France, with a statement of their qualities for cider-making, as well as of the characteristics and qualities of the cider they severally yield, together with recommendations for mixtures to heighten quality. Not one single apple named on this list can be identified with any American variety. The whole list and all the analytical notes are absolutely valueless here. Reference is also made, in the same work, to the same embarrassment in reference to German apple analyses, of which it appears that many have been made.

The only facts of value to be drawn from both the French and the German works are the general averages of proportions of saccharines, acids, etc., and a few other facts hereinafter mentioned of like general nature. The general results are as follows:

In some analyses made at the Agricultural Institute, at Hohenheim, Germany, of all the cider-apples then grown at that establishment—21 in number—the specific gravities of the juices were from 48° to 75°, the sugar (supposed to be separated from other solids) 5.4 to 8.3, the acids (as malic) from 0.62 to 0.23.

In other analyses, made under direction of the agricultural society of the Eure, in France, the following general results were obtained:

	Green.	Ripe.	Overripe or spoiled.
Water, - - - -	85.50	83.20	63.55
Saccharines, - - -	4.90	11.00	7.95
Cellular tissue, - -	5.00	3.00	2.00
Gum, - - - - -	4.01	2.11	2.00
Albumen, - - -	.10	.50	.00
Acids, oils, and other matters,	.49	.50	.60
	100.00	100.31	76.10

The loss of 23.90% in the last column is said to be due to evaporation of water and alcohol, the latter pre-

sumably produced by fermentation of juice in the broken cells of the spoiled fruit.

In passing, it is well to note the increase in sugar from the green to the ripened stage. This seems to have been accomplished at cost of the cellular tissue and gum, both of which have been diminished, a change which chemistry fully explains.

Other analyses by the distinguished chemist, Fresenius, gave the following averages:

	Per Cent.
Sugar (supposed to mean actual sugar, exclusive of starchy substances), - - -	8.37
Acids, - - - - - - - - -	.75
Extractives, cellular tissues, etc., - - -	4.20
Water, - - - - - - - - -	86.68
	100.00

The same chemist gives also the results of the analysis of an apple of the same variety, in three successive years, showing how the seasons may vary the quality.

	1853.	1854.	1855.
Sugar, - - - - -	9.25	5.96	6.83
Acids, - - - - - -	.58	.39	.25
Extractives, - - - -	86.03	82.03	82.04
Water, - - - - -	4.19	11.62	10.28

Again, it is to be noticed that in the year of highest perfection, 1853, the sugar is increased at expense of the extractives, cellular tissue, etc.

In our own country, the earliest analyses found are those by Dr. J. H. Salisbury, of Cleveland, O., published in the United States Patent Office Report (Agricultural), 1850, p. 522. They are as follows:

Proximate organic analysis, average of six varieties of apples, viz.: Talman Sweeting, Swaar, Kilham Hill, Roxbury Russet, English Russet, and Rhode Island Greening. One hundred parts of fresh apple gave:

Cellular fiber,	3.20
Glutinous matter, with a little fat and wax,	.19
Dextrine,	3.14
Sugar and extractive,	8.32
Malic acid,	.32
Albumen,	1.38
Casein,	.16
Total dry matter (solids),	16.71
Water,	82.66
Loss,	.63
	100.00

Of these apples the Talman Sweet contained largest amount of saccharines and extractive,	9.90
And least amount of malic acid,	.25
The English Russet came next, as follows:	
Saccharine and extractive,	9.35
Malic acid,	.30
The Swaar had most acid,	.38
And of saccharine and extractive only,	8.10

Besides the malic, apples contain a small quantity of tannic and gallic acids. These were found in larger proportion in the Russets than others, easily detected by the (astringent) taste, and by the inky color produced by cutting with a steel knife.

Other analyses, much more in detail, as well as greater in number (23 analyses of 17 varieties), have been made in the chemical bureau of the Department of Agriculture in Washington, as shown in the Commissioner's Annual Report for 1886, p. 354. The averages found for the original samples are as follows:

	Per Cents.
Water,	86.43
Solids,	13.65
	100.08

The solids contained—

	Per Cents.
Of saccharine (glucose and sucrose),	10.26
Malic acid,	0.62
Fiber,	0.96
Albuminoids,	0.11
Ash (potash, lime, soda, etc.),	0.29
	11.28

Of these all except the fiber are in solution, and would affect the saccharometer. Such juice would mark 11.28 thereon.

The 17 varieties analyzed were named:

	No. of analyses.	Saccharines.	Acids.
Smokehouse,	5	10.08	0.61
New York Pippin,	2	not given	not given
Fall Pippin,	2	10.20	0.71
Maiden's Blush,	1	9.74	1.05
Northern Spy,	1	10.40	0.54
Ben Davis,	1	10.50	0.54
King,	1	8.50	0.43
Smith's Cider,	1	8.96	0.62
Rambo,	1	10.65	0.40
Blush Pippin,	1	8.65	1.18
Paradise Sweet,	1	10.46	0.19
English Redstreak,	1	10.92	0.54
Winesap,	1	11.78	0.67
Nonesuch,	1	11.96	not given
Golden Pippin,	1	9.92	0.83
Lobster White,	1	9.70	0.39
Virginia Crab-apple,	1	12.77	0.56

The analyses were all made between September 22 and October 22. Unless the apple named King in the last list is the same as Tompkins County King in Dr. Salisbury's analyses, none of the varieties in the American analyses were the same.

Bringing the general facts of all the various analyses into one table, for convenience of comparison, they appear as follows, in per cents:

Analyses.	Water.	Sacch.	Acids.	Rem's.
Hohenheim (Knauss),		6.85	0.43	
Eure (ripe sample),	83.20	11.00	0.50	5.30
Fresenius,	86.68	8.37	0.75	4.20
Hohenheim (Wolff),	86.60	7.81	0.38	5.21
Cleveland (Salisbury),	82.66	11.46	0.32	5.56
Washington (Dep. of Agri.),	86.43	10.26	0.62	2.69
Averages,	85.11	9.29	0.50	4.59

Putting these in round figures, it appears that apples are composed of:

Water,	85.00
Sugar,	10.00
Acids,	.50
Fiber, or cellular tissue,	4.50
	100.00

Although apples thus appear to be more than five-sixths water, yet the proportion of *juice* is still greater, since the saccharines, acids, and other soluble materials are all dissolved in the water. The juice therefore really constitutes fully 95% of the fruit. But this amount is much more than can be extracted by any ordinary means employed in cider-making. With the best mills and presses, the yield is only about four gallons of juice, weighing about 36 pounds, from a bushel of apples of 50 pounds, which is only 72%. Probably 50%, or one-half of the apples, is more commonly obtained than the higher figure. The difference is quite material, amounting, as it does, to nearly 50% increase of product, which increase is clear profit, since the expenses are nearly the same for the lesser yield as for the greater.

It appears, also, from these analyses, that the average amount of saccharines in juices varies from 10.26, by the last analyses, to 11.47 in the first, per hundred of juices. The importance of this will be appreciated when

it is known that it is from these elements exclusively that the alcohol of cider and wine is produced. The less saccharine the less alcohol, the weaker the cider, and the more difficult to keep. The average amount of saccharines in grape-must has been determined, by numerous analyses made at the University of California, to be very nearly 22%, from which it is to be seen that cider from average apples can only be half as strong in alcohol as wine from average grapes. This fact accounts, mainly, for the greater difficulty in keeping ordinary cider. If average wines were no stronger than average cider there would be just as much difficulty in keeping them. But a grape-must showing only 10 to 12% of saccharines would not be considered as fit to make wine. In Europe such must is usually made into light wine for immediate use, but never into wine to be offered in market. In California the minimum standard for must is placed at 22%, and wines with less than the 10.68% alcohol due to that amount of saccharines are salable only at correspondingly reduced prices, and for distillation.

Looking through the American analyses there are to be seen quite considerable differences among the several varieties of apples, in respect to saccharines, and also in acids. Rearranging the last list in the order of their saccharine strength, they stand as follows:

	Saccharines.	Acids.
Virginia Crab-apple,	12.77	.56
Nonesuch,	11.96	not given
Winesap,	11.78	.67
English Redstreak,	10.92	.54
Rambo,	10.65	.40
Ben Davis,	10.50	.54
Paradise Sweet,	10.46	.19
Northern Spy,	10.40	.54
Averages,	11.18	.49

Fall Pippin,	10.20	.71
Smokehouse,	10.08	.62
Golden Pippin,	9.92	.88
Maiden's Blush,	9.74	1.05
Lobster White,	9.70	.89
Smith's Cider,	8.96	.62
Blush Pippin,	8.65	1.18
King,	8.50	.48
Averages,	9.46	.73

The division of the list into two parts is to bring out the following:

It is to be noticed, in the foregoing table, that in a general way acids increase as saccharines diminish; so that the poorer a cider in alcohol, the more acid it is; not only comparatively, but actually; comparing the average in saccharines of the first eight with that of the last eight, the latter is found to have diminished from 11.18 to 9.46%, while the corresponding acids show an increase from 0.49 to 0.73. We are, therefore, justified in the conclusion that apples best adapted for cider, in respect to saccharines, have also least proportion of acids.

That this reduced proportion of acids is an additional advantage will be seen when comparison in this respect is made with California grape-must; wherein the average acidity is 0.50 per hundred, while apple juice, as shown by these analyses, runs from .19 in the Paradise Sweet up to 1.18 in the Blush Pippin; the average of all being .62. Such a proportion as .62 would not be greatly excessive if always accompanied by a due proportion of saccharines, but with less than such equivalent it yields a cider which, when hard, is altogether too tart. This results from the lesser amount of glycerine, as well as alcohol, in the weaker cider produced from such fruit. (See Glycerine.)

There is another important fact indicated by these

American analyses. It is to be seen, in the first place, that the Talman Sweet has the largest amount of saccharines, with the least amount of acid; and by the second set that the Paradise Sweet, while not sweetest, is still above the average, and at the same time carries much the least amount of acid, even so little as less than half the amount of the next lowest of the others, and less than one-third of the average of all together. It is to be inferred from this that sweet apples are sweet by reason of both an actually greater proportion of saccharines and a less amount of acid. These qualities render them of very great value in cider-making, though they may not make the best cider by themselves. It appears, by the list of French apples before referred to, that more than half the apples therein approved for cider are sweet.

It is greatly to be regretted that analyses of these fruits have been so few in number and so limited in scope. There are many questions of a general nature relative to all apples, as well as all those special ones arising from differences of varieties, which require thorough and exhaustive investigation before the most perfect mastery can be obtained of the art of cider-making. The analyses of the Department of Agriculture are certainly the most comprehensive, complete, and satisfactory yet published, but are still far too few in number to permit of such general deductions as may be considered established facts. That requires great numbers of analyses on all varieties of the fruit, collected from all sources of production, all varieties of climate and soil, at various stages of maturity, and repeated through several seasons, before all the facts can be gathered which shall tell us the "reason why" of every step, and place the art on the basis of an exact science. Until that is done we must be content to grope our way along, borrowing light from the twin art of wine-making, as far as may be done, and approach as near as we can to

the highest excellence by the empirical method of "cut-and-try," without understanding thoroughly the reasons of success or failure, nor when or how we may surely attain the best result which the material at any time in hand can be made to yield.

We have shown that apples are more than nine-tenths juice, and that such juice consists of water, saccharines, acids, and extractives. It is well now to re-state briefly the several uses which those materials serve in the conversion of juice into cider.

Water acts solely as a diluent. As has already been shown, there is too large a proportion of it in all apples. To add water to apple juice, as is sometimes done, in pressing, is simply to destroy it.

Saccharines furnish all the alcohol, and, by means of the glycerine produced in fermentation, all the sweetness remaining in hard cider or dry wine. A small portion of acid also is produced from saccharines.

Acids give flavor and aroma by their special individual tastes, and other flavors and bouquet by the ethers resulting from their contact with alcohol.

Extractives impart body, or substance, as also a certain portion of the softness and smoothness, in which they are assisted by the glycerine.

CHAPTER IV.

APPLES, VARIETIES, AND TESTS.

It is a general rule that "the better the apple the better the cider"; but this is not to be understood as meaning that the apples best for eating are always best for cider-making. It is certain, however, that poor, watery, or flavorless apples can never yield good cider, and it is equally certain that such apples as the Spitzenberg, Seek-no-further, Rhode Island Greening, Tompkins County King, and Swaar, all of which are among the best table fruits, do make most excellent cider. But there is another class of apples, comprising Russets and Crabs, which make the best of cider, and yet are never of the highest quality for table use. They assuredly do attain, in time, to a condition which admits of presenting them at table, but it is at a season when the other varieties, better liked for that purpose, are generally gone, and the apple-lover must use Russets and Crabs, or wait another harvest.

Of whatever variety of apples cider is made, it is of the greatest importance that the fruit be carried to the highest maturity before that work begins. The French recognize three stages in the maturing process, which they denominate severally, "Maturity of vegetation" (growth); "Maturity of honeying" (ripening); and "Maturity of expectation," which, being rather difficult to define by any synonymous English word, may be best explained by translating the text, "The 'Maturity of expectation' uses or combines the scattered principles to form sugary matter, which thereafter abounds in the apple." Probably the three periods are those known to us as the growing, the ripening, and the sweating periods or stages; the first and second occurring on the

tree, and the last taking place after the fruit is gathered.

Whenever it is done, sweating is of very great importance to the quality of the cider. Its most obvious effect is to reduce weight by evaporation of part of the water of the juice, which, as elsewhere shown, is always excessive. By this it produces, indirectly, an increase in the *relative* proportion of the saccharines. Our analyses have shown the fact in two instances. The same thing also occurs in the ripening of the grape.

How this change is effected is explained by chemistry. Silliman's Chemistry says: "Cellulose (fiber and tissue) is identical in composition with starch and dextrine. By action of strong sulphuric acid it is dissolved and converted into the latter substance.* The experiment is easily tried with unsized paper or cotton. To two parts of this one part of the acid is very slowly added, taking care to prevent heating, which would char the mixture. In a few hours the whole is converted into a soft mass, soluble in water, which is principally dextrine. If the mixture is now diluted with water, and boiled three or four hours, the dextrine is completely converted into grape sugar, which can be obtained by neutralizing the acid with chalk or lime and evaporating. By this process paper or rags will yield more than their weight of crystallizablo sugar.

Apples which are not completely grown contain a large quantity of starch, but no sugar. After the fruit is fully grown the starch gradually disappears, and in its place we find grape sugar. This change constitutes the ripening of fruits, and, as well known, *will take place after they are gathered.* In this process we have clearly a conversion of starch into sugar by the agency

*The fiber here referred to is the hard, tenacious, unchanged fiber of wood, cotton, linen, etc. The fiber of the cellular tissue of apples is quite different; it is less tenacious, and like the former after that has been partially reduced by strong acid.

of vegetable acids present in the fruit, a change independent of life."

Of course, the conversion of tissue into saccharine implies a thinning down and weakening of the cells containing the juice, whereby their power to resist pressure is very much reduced, and the apple becomes softer, or "mellow." The loss of water at the same time contributes to the same effect.

How much the condensation by evaporation amounts to is unknown to me, as no data on the subject of sufficient authenticity to be entitled to confidence has come under my notice. Six to eight per cent has been mentioned, but, be it more or less, it is a sure gain to the quality of the cider product, and should therefore be promoted by every means consistent with economy.

Wherever stored after gathering, apples should not be placed in large heaps, nor should they be stored in closed sheds, barns, or bins; but they should be exposed, in small piles, to the air, wind, and sunshine. They must also be kept perfectly clean, sound, and free from all foreign odors, especially so from mustiness. If allowed to lie on the ground for more time than necessary to gather them, they will take an *earthy flavor*, known in wines as *goût de terroir*, which will neither leave them nor the cider made therefrom.

It is no uncommon thing to see apples collected in heaps *on the ground* under the trees where they grew, and so left for a week or two before being carted to the mill, where again perhaps they were stored in large closed bins for another equal period,—a very sure way indeed to diffuse the earthy and musty flavor, with any others they may have acquired, and of thoroughly infecting the whole stock.

So long as there is no danger of freezing, apples had much better be left out in small piles, raised from the ground on a floor of boards, rails, cornstalks, or even a

good thick carpet of sound straw or hay, than to be stored in bins in a cider-mill or in a barn. The air will then have freer access and more thorough action upon them, and they will condense much more and mature much faster than in other situations. It will also afford an opportunity to make tests; to ascertain, before mixing, which varieties may enter into a mixture with most benefit, and which should be excluded altogether, as unfit for cider. Danger from light freezes may be averted by covering the heaps overnight with straw or hay, or even with old newspapers.

In shaking apples from the tree, much will be gained by use of a harvesting blanket, made to surround the trunk of the tree for about fifteen feet each way. If made of new material it should be of stout drilling, ticking, or canvas, and be supported by eight stakes, set with a crowbar; each stake having a shoulder, or notch near the top to receive a loop of cord fastened to the edge of the blanket, and keep it above the ground. The center may either lay upon the ground, if turf, or be tied to the body of the tree above the ground. The blanket may be in four pieces, each a quarter circle, for convenience of handling and for other purposes, and the four pieces must be joined in one, for apple-gathering, by a stout cord rove through holes made for the purpose, one seam being open to enclose the tree. When shaken off the tree over such a blanket the apples all roll to a ring near the center. Very few will be injured; none will be smeared with mud or animal filth, and the labor of picking up, especially from muddy ground, will be saved.

Such a blanket will require eighty square yards of material, which can be bought for twelve to fifteen cents per yard, and if made up at home will require an outlay of no more than about twelve dollars. Very little will be lost in making it over for other uses, in case no longer

needed, though it will have many other applications, about a farm, besides that of apple-gathering; as, for example, protecting a fruit- or flower-bed, a fruit-tree or grape-vine, overnight from a late spring frost; protection of an exposed place about the house where some one of the household has some trying labor to perform for a day or so; protection of a load or an incomplete stack of grain from storms in harvest. Last, and not least, with a small additional center-piece and a pole, it will make a very neat tent for picnics and parties. If need be, it can be the joint property, for harvest use at least, of several neighbors. It is said that thorough soaking, previous to use, in a solution of sugar of lead, drying, and then dipping in lime-water, will prevent mildew and render it nearly waterproof.

We will suppose our apples to have been harvested and carefully sweated, and to be now ready for cider-making. They are yet in heaps, each kind by itself, under the trees where they grew. In order to haul them to the mill they must be mixed. Now comes the critical question: How shall they be mixed? It will not do to throw them together indiscriminately; some may be worthless for cider, and be able to damage, if not to destroy, the entire product, and others, if not quite so bad, may possess qualities, or want of qualities, that unfit them for cider; and that the cider will be all the better without. What we are aiming at is high quality in our product. It certainly can not be obtained by an indiscriminate mixture of all our fruit, regardless of quality. It will not do, even with grapes, so much richer in wine-producing properties, and surely not with apples; the greater deficiencies of which, in those respects, demand the more careful judgment, the more skilful blending, and, above all, the most absolute rejection of all those which can in any degree depreciate quality.

How, then, are we to mix our apples? Assuredly

they should be so mingled that one kind may make up for the deficiencies of another, and that the blend, as it is called, shall be better than the cider made of either one of the varieties alone. In short, so that each shall contribute something toward, and detract nothing from, a complete and generous whole. To do this intelligently it is necessary to know something of the constituent proportions of the various fruits, in order to bring them together harmoniously, and especially to avoid making use of any which are nearly or quite worthless or injurious to our purpose. Good wine is obtained in that way only, and it is the only possible way to obtain good cider.

Whoever thinks that "any apple is good enough for cider" had better not engage in the business. He probably would not know a good article of cider if by any accident he should ever taste one. This book is designed to guide those who intend and desire to make the best, and are to be satisfied with nothing less. Incidentally it teaches how to make the most of imperfect material, but the most perfect product can only be made with the best material. Rest assured that this is eminently true in cider-making. Poor material had better be used in other ways, where it can do no harm, and may possibly be made to yield profit; but to use it to deteriorate quality of a product where quality is the first and highest consideration is simple foolishness.

Here comes into play, for the first time, our little saccharometer, also our standard solution. We take a dozen or so of apples *of one sort*, some from each tree of the same variety, provided all the trees have perfected their fruit. If the apples of any one of the trees are below average, discard them from the collection and test them separately. Crushing or grinding those taken in any way convenient—grating with a hand-grater is perhaps as little work as any—twist the pomace in a stout cloth strainer until a test glass full of clear clean juice is

obtained. Into this plunge the saccharometer slowly and carefully, until it floats without any rise or fall. Then note the reading, say 14½°. Remove the saccharometer, and immediately introduce the fluid thermometer, and after two or three minutes remove it and take the reading. Note down these readings, with date, and variety tested, thus:

Oct. 28, '89—17 trees Spitzenbergs, S. 14½°—T. 73½°—15°;

which means that on the 28th of October, 1889, you ground up together samples from seventeen trees of Spitzenbergs, and found the juice to mark 14½° on the saccharometer, at the temperature of 73½° F., which being above 60° requires (by the table, p. 25) an addition of ½° to give the true strength, viz., 15°. If we had found the thermometer to show only 42¾° F. instead of the above, we should then have had to deduct ½°, and the true strength would then have been 14° for the saccharometer mark 14½°.

We now know that the juice of our Spitzenbergs averages 15% in solids, consisting of sugar, acids, and extractives. That will do very well for saccharines, of which the 15° mainly consists. The cider will be over 6½% spirit. The next thing is to ascertain how it is to be in regard to acidity. If we find an excess of free acid we will know that unless we find some means of correcting it, our cider, though standard in spirit, will still be excessively hard, and on that account probably unsatisfactory to consumers and difficult to sell. The test is made by means of the standard solution heretofore described. (See Standard Solution.)

Supposing, in this case, we find the acidity to amount to 0.75, having required 1½ ounces of solution to neutralize one gill. We see at once that the cider produced from that juice, though strong enough in alcohol, will nevertheless be too tart when hard. It needs to have

the proportion of acid reduced in some way, without reducing the saccharine below the 12° necessary to make a cider up to commercial standard. How is this to be done?

If we add water sufficient to bring the acidity down to 0.60, it will take an addition of one quart to every gallon. This will also bring down the saccharine from 15° to 12°, and though the juice will remain standard, in that respect, still the extractives will be reduced. But suppose we prefer not to reduce the saccharine; we may then, perhaps, find an apple of some sweet variety, the juice of which is as much below 0.60 as our first is above, say showing only 0.45 of acidity, with 15°, or nearly that, of saccharines. Obviously, then, these juices will both be bettered by the mixing or blending. Mixed in equal parts, the blended juices will yield a cider having 0.60% free acid, since 0.75 and 0.45 added together and divided by two give 0.60, and will still remain at or near 15° in saccharines; and as we have used no water we have not affected the proportion of extractives.

There are other ways of effecting the same purpose, when we are unable to find an apple with due saccharine accompanied by deficient acid. We may find an apple deficient in both saccharine and free acid, but of such high flavor as to warrant the opinion that by using its juice we may bring down the acidity to standard without weakening the extractives, though in so doing we reduce the saccharines also below standard. In that case we may add sugar, to establish the due proportions of saccharines. Of course we could take that way in the first instance, but it is expensive, and to be avoided when the end in view can be reached without, as may often be done by blending in the way described.

The juice of sweet apples of low acidity constitutes a very large share of the apple juice used for cider by the French. Such juices may be concentrated by heat-

ing, and be used with great advantage in the way described.

In using sugar to bring a juice up to standard, or up to wine standard (22%), it must be remembered that one pound of the best granulated sugar in a gallon will raise the saccharometer $11\frac{1}{2}°$. Remember, this does not mean a pound of sugar put into a gallon of juice, for that will make more than a gallon (about three gills), but it means a gallon made up of one pound of sugar, with juice to complete one gallon. That will read on the saccharometer whatever the juice read originally, plus $11\frac{1}{2}°$.

Sugar is extensively used in this way to adjust the saccharine strength of grape-must in all those vine-growing regions where the summers are too short and too cold to bring the grape to its highest maturity.

But it will be asked, Is the sugar thus introduced the same saccharine as that produced by nature in the apple? The answer is that it becomes identically the same very soon after being brought into contact, in solution in the apple juice, with the acids therein. Cane sugar is known to chemists as sucrose; starch sugar is known by two names, dextrose and glucose; and fruit sugar is known as fructose. The saccharines of fruit are a mixture of equal parts of glucose and levulose, and the two are of exactly the same composition. Cane sugar dissolved in water containing a little organic acid is changed in a short time into a mixture of equal parts of glucose and levulose, precisely the same as that contained in fruit. Once so changed it can never be restored to cane sugar. That is the chemistry of the subject plainly told; there is only one thing omitted from it, and that is, the change is accompanied by an increase of quantity; one hundred pounds of cane sugar becomes one hundred and five and one-half pounds of fruit sugar by taking into combination five and one-half pounds of water.

These facts being clearly established by chemistry, it

is in our power to readjust the proportions in juices and always to bring them to standard before fermenting them. It is better to do this by use of juices when most convenient. If we will concentrate our sweet apple juices of low acidity, the readjustment may often be done without recourse to the sugar barrel. Take, for instance, the juice of the Paradise Sweet before referred to in the analyses by the Department of Agriculture: its saccharines were 10.46 and its acidity 0.19; by evaporating this, two into one, it would then stand, saccharines 20.92 and acidity 0.38. Now, if we had another juice, say some of our Spitzenberg, standing as we supposed at, saccharines 15° and acidity 0.75, and we add one gallon of our concentrated juice to every two of that, we shall get a juice standing, saccharines 16.97 and acidity 0.63. This being above standard in both respects, as well as in extractives in the concentrated juice, may be reduced, if desired, to standard, with water, by adding one gallon for every twenty.

The method of using concentrates is of very old, and in some respects, very constant practice, in wine-making.

The fruit having been all thoroughly tested and memoranda made, not only of the mixtures decided upon, but also for comparison another year, the fruit may now be carted to the mill, the mixtures being made during the collection from the ground or in the bin at the mill. Great care should be taken, in collecting, to throw out all defective and decayed fruit, for which purpose it should all be picked up from the heaps by hand.

If the cider is to be made at a custom mill, it is best that it should be ground as soon as possible. Such establishments as have come under the writer's notice have been tainted with foul odors of decaying pomace, vinegar, and not infrequently of animal excrement, all of which are promptly taken up by the fruit stored, as well as by the cider made therein. The odors other

than the vinegar may be destroyed by burning sulphur, provided the storage bins, mill, and press-rooms can be closed quite tightly. Otherwise little can be done. Decaying pomace may be covered with earth, or better, if possible, by dry road-dust.

Neither the mill, the press, the tanks nor utensils should be used until they have been most thoroughly scrubbed with boiling hot lye, made from *wood* ashes. If this is not obtainable, potash must be procured and boiling hot lye, of that a pound to the gallon, used with brooms and brushes on every surface with which the juice may come in contact. If this does not remove all traces of vinegar, and other taint or smell, give up that mill and sell your apples, or cart them elsewhere.

CHAPTER V.

APPARATUS FOR CIDER-MAKING.

It is not the purpose of this book to advertise any particular mill or class of mills or presses. They are offered in market now in great perfection and of all capacities, from that required by the largest establishment, driven by steam power and turning out hundreds of barrels per day, down to the diminutive family mill operated by hand, and producing a single barrel or less in the same time. Each manufacturer claims special advantages for his own style. In general they conform to one of two methods for reducing the fruit to pulp. Either it is grated by means of a rotary rasp, or scraped into pulp by rotary scrapers, or it is crushed by variously contrived compressors. The differing methods each have their

strenuous advocates, according to their varying interests, which are usually centered upon a patent they control covering some particular form or feature.

As to presses for extracting juice from pulp, their variety and capacities are as great as those of the pulping machines. With few exceptions, they are screw presses. The larger ones operate by steam power, through gearing, the smaller ones directly by hand. Some combine the lever with the screw, by means of a knuckle- or toggle-joint, whereby immense force is exerted, while others exert nearly equal force by a combination of cog-wheels applied to the screw.

The illustrations we give show various forms and capacities of the most effective mills and presses, from the small hand-mill for family use up to the largest manufacturing sizes.

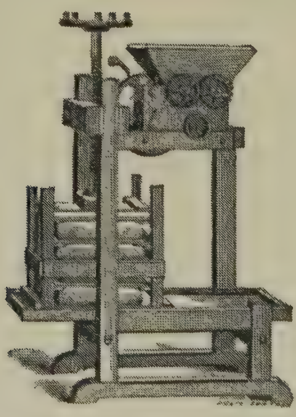


FIG. 4. A mill and press combined. It is very complete, handy, and perfect for family use, where only ten or twenty barrels of cider are to be made in a season, and those at different times as different varieties of apples may severally mature into suitable condition. It is alleged to have capacity of two to three barrels per day. It might, therefore, easily serve for several neighbors, as it weighs only about 250 lbs, and is easily moved. For that amount of service, it would save all hauling of apples and barrels to mill, as well as that returning the cider home.

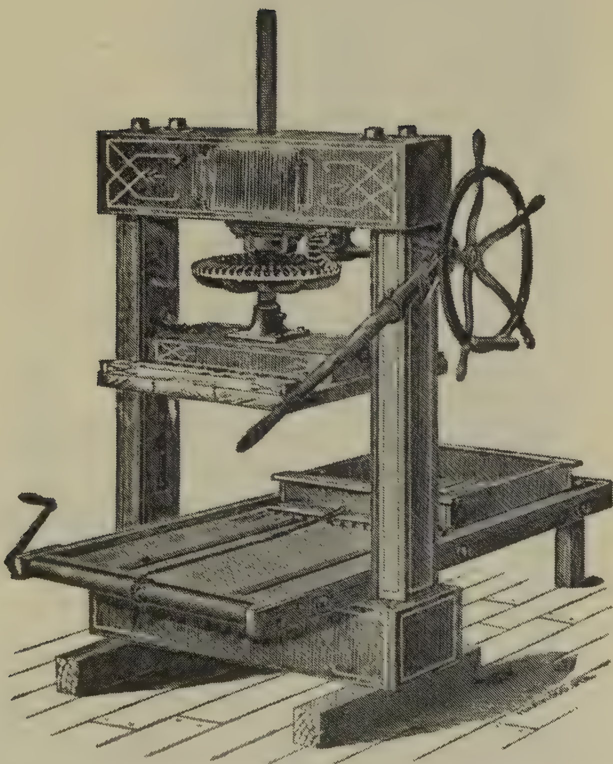


FIG. 5. A geared hand-press of great power and usefulness, adapted alike to cider- and to wine-making. This and all the following presses are without pulping apparatus, which for this and the following require to be driven by power. This press is claimed to have capacity of twenty barrels per day.

FIG. 6. A mill and press complete, the mill to be driven by horse or other power, and the press to be worked by hand. It is quite complete and light,—the entire weight being only about 600 lbs,—and may serve the requirements of one or of several neighbors. It is claimed to have capacity of ten to fifteen barrels per day. The platform is of sufficient length to permit the laying up of a second cheese while the first is being pressed.

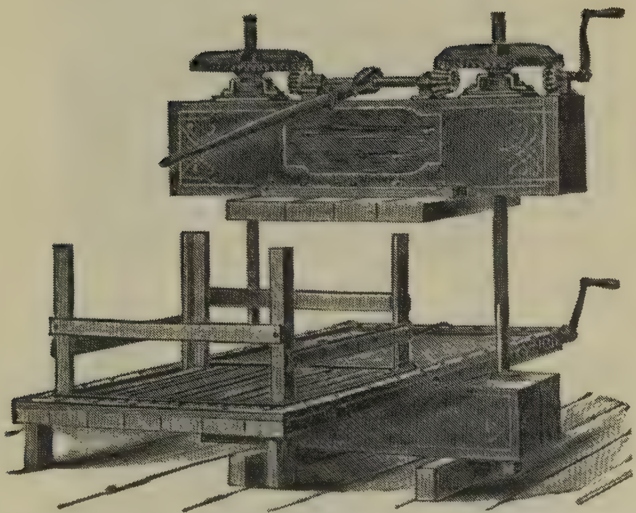


FIG. 7. This press differs from the preceding mainly in having larger size and capacity, and two screws in place of one. The gearing is the same in both, and the single screw has the same power as the two screws, but the greater size of the cheese in this seems to require two screws which move simultaneously, and impart great steadiness. Capacity about thirty barrels per day. An enlarged size of this press is manufactured, which requires to be driven by power. For this purpose it is supplied with proper appendages.

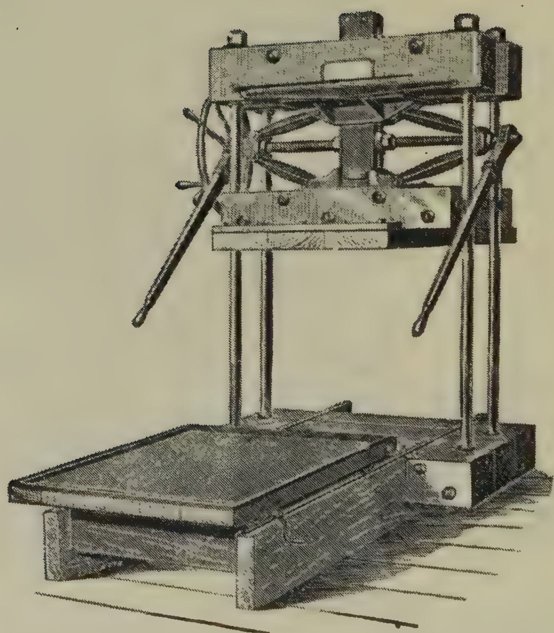


FIG. 8. A knuckle- or toggle-joint hand-press, adapted to both wine- and cider-making. It is capable of exerting great force, which steadily increases down to the last, so that as the cheese becomes drier, the force is still adequate. The capacity is said to be thirty to forty bushels of apples in one cheese, which should yield four or five barrels of juice. Four barrels per cheese, and one cheese pressed per hour would be forty barrels per day. It should be fitted with the double, or drag platform, for two cheeses, like that in the next.

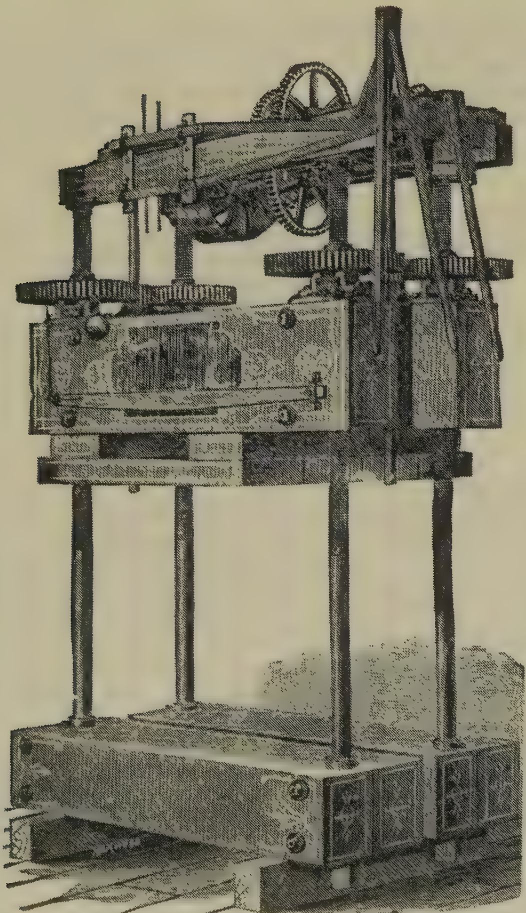


FIG. 9. A very large and powerful press, suited to an extensive manufacturing business. It has four screws, which move simultaneously and bring the pressure to bear uniformly upon all parts of the cheese. The platform is omitted. Of the latter there are quite a variety of forms and styles, adapted to all the power presses; some on tracks, and some revolving, but all designed to facilitate the building and removal of the cheeses, so that the press may be kept in action continuously with least amount of interruption and delay.

In all these presses the cheeses are built up of successive layers, each enveloped in a press-cloth, and kept separate from the others by means of "racks," which are so constructed as to furnish open channels for the

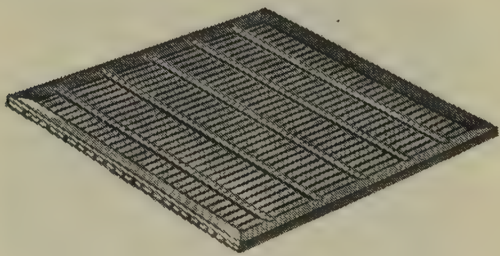


FIG. 10. BEVELED RACK.

outflow of the juice from the very center of the largest cheeses. The forms limit the size and thickness of these layers. They are square in shape, and usually three or four inches deep. The racks are a little larger than the forms, and are usually made of slats or strips of wood,

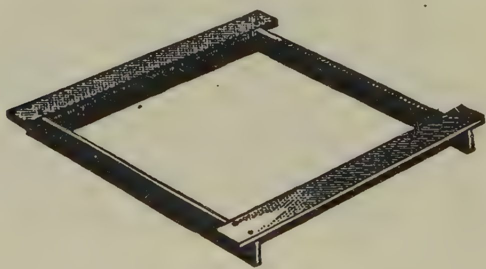


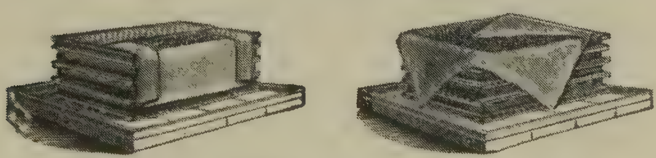
FIG. 11. FORM.

one-half by seven-eighths inch, nailed to a sufficient number of cross-pieces to hold them securely in place, but with intervals or open spaces of one-fourth inch

between each successive pair. These openings are the channels by which the juice flows out. The best racks are now made with edges beveled (thickened), to take up the slack or fold of the press-cloth, which fold accrues from the collapse of the layer as it yields its juice to the pressure.

The method of building a cheese is this: a rack is placed on the platform; on that the form is fixed and covered with a press-cloth of sufficient size to completely envelop the layer. Pomace is then dipped into the cloth until the form is full. The cloth is then folded over the surface and the form removed. This completes one layer of the cheese. Another rack is then laid on this layer, the form placed on that, another press-cloth spread over and filled as before. This process is repeated until the press is filled. The cheese, thus built, is now moved under the screws, and while being pressed a new cheese is built in the same way.

It will be seen, from this description, that the successive layers of the cheese are no more than three to four inches thick at first, and that they are separated from each other by the racks which provide open channels to lead the juice from the center to the exterior. The lay-



FIGS. 12 and 13. METHODS OF FOLDING PRESS CLOTHS.

ers are very quickly reduced by the pressure to an inch or so in thickness, and in consequence, as the pressure progresses, it actually occurs, with this apparatus, that there is an open channel or duct for the outflow of juice within half an inch of every particle of pomace in the

press. Several ways of folding press-cloths are shown in Figs. 12 and 13.

The difference in effect of the two methods of reducing, as between crushing, on the one hand, and pulping, on the other, is worthy of consideration, in view of the difference of yield they severally give. This is a question which has been the subject of serious and exhaustive investigation in France, with reference to pulping and extracting the juices of the sugar beet for sugar manufacture. The results there attained were then applied to reducing the apple for cider-making.

The following comparative table of results obtained by the two methods is translated from the French work on cider-making hereinbefore referred to:

Table showing quantities and qualities of juices per hundred pounds, obtained from four different kinds of apples, by various means of reducing and extracting.

Apples. Names of varieties.	Crushed. Juice per 100 lbs.	Crushed. Saccharine strength.	Rasped. Juice per 100 lbs.	Rasped. Saccharine strength.	Difference in quality of juice per 100 lbs.
Aufrielle,	52	9			
"	50	9			
"			70	9	18
"			68	9	18
Ente-au-Gros,	67	8			
"	65	8			
"			85	8	18
"			83	8	18
Paradis,	63	6			
"	61	6			
"			81	6	18
"			79	6	18
Goudon,	64	5			
"	62	5			
"			82	5	18
"			80	5	18
	8:484		8:628		
Averages,	60.5		78.5		18

NOTE. The crushing was perfectly done—much more so than ordinarily.

The saccharine strength given probably comprises sucrose alone.

The difference in quantity of juices yielded by the two samples of each variety treated alike as to reducing, came from differences in presses used. This difference it is unnecessary to consider here, since both the styles are antiquated, clumsy, and expensive; albeit they seem to have been very effective. There appears, however, to have been a strangely uniform difference in yield of juices of 18 pounds per hundred between the methods by crushing or rasping, and always in favor of rasping. At the same time the quality of the juice from each variety remained constantly the same by either method.

This difference of 18 pounds of juice per hundred of apples means much more than a difference of 18 per cent; it amounts to an increase of over 30 per cent, and a quantity of apples which would yield 77 barrels by crushing would yield 100 by rasping, the quality of the juice remaining the same.

It is thought, by the author, to be doubtful if excessive power in cider-presses is as desirable as might be thought, on first consideration; for the reason, believed to be true, that the juice obtained with extreme pressure is not so rich as that which flows at the mean. It is yet too early to speak positively on this point; the tests are not yet sufficient in number to be regarded as establishing facts, but so far as they go they indicate that the juice which flows last is from one to one and one-half per cent less rich in saccharines than that obtained at the mean or middle pressure.

The fact, if such it proves to be, may perhaps be accounted for by the other fact that such juice comes in part, if not largely, from cells not broken by the rasp, but which burst in the press. Such cells would, supposably, be those which had resisted or escaped the rasp by reason of the superior strength of their walls, due to

the fact that the tissue of which they are formed had not been so much reduced by conversion to saccharine as had the others which were broken; consequently their contents of juice were less sugary.

This reasoning is in line with the other facts of ripening hereinbefore mentioned, and seems to give them confirmation. Still, as has been said, they are by no means established.

This question of relative richness of first and last juices obtained from pressure of pomace is another of those which needs that careful and extended investigation which government alone can afford to bestow. It may be found that some apples having high qualities as to flavoring effects are rich enough in their "middle register" to make them valuable cider fruit, notwithstanding that parts of their juices have to be rejected. It is important, also, to determine whether the juice is uniform in its proportions of acid. Judging by the irregularity of the saccharine, and the fact that low saccharine strength is usually accompanied by high acidity, it may reasonably be conjectured that differences in this respect will also be found pointing in the same direction, viz., toward rejection of some portions of the juice when high quality is sought. That is a common practice in wine-making, and champagnes are made only from the first and second "tailles," as the successive pressings are called.

STRENGTH OF JUICE NECESSARY FOR GOOD CIDER.

The important question now arises, what strength should apple juice have to be capable of making merchantable cider, which will keep through the year, and bear the exposure and disturbance of transportation? The ability to withstand these tests is not dependent altogether upon the quality of the juice, but depends on

the skillfulness and perfection with which it has been made into cider. If the cider is perfectly freed from all disturbing elements; if all saccharine has been fermented into alcohol, and all ferment germs have been devitalized; if all lees have been thoroughly removed, and no acetous action supervened; and especially if the package has been protected against the penetration of air; cider may be considered safe if it contains six per cent of alcohol. But that amount is a minimum, perhaps an extreme minimum. The greatest danger—in fact, about the only danger—to such cider is from admission of air to the barrel, which will soon convert the cider into vinegar. If that be absolutely excluded no harm can accrue to it, and it will steadily improve in quality for a year or two. But it must be remembered that this applies only to a perfectly-made cider. It bears no assurance for any other.

To produce cider carrying six per cent of alcohol the juice must contain not less than 14° of solids by the saccharometer. Such juice will contain, besides saccharine, about 1½° of extractives and acids. Deducting these, there remains 12½° of saccharine convertible into alcohol by fermentation. Multiplying this by 48.55, ascertained by Pasteur to be the alcoholic equivalent, per cent, of fruit sugar, we obtain 6.0875, or very nearly six and one-tenth per cent, as the possible alcoholic strength such juice can yield. Fourteen degrees on the saccharometer may therefore be set down as the minimum standard of apple-juice for cider purposes.

Even this cider can not be kept in wood beyond the ripening period. In such it will mature more rapidly, but will also go rapidly beyond maturity and turn to vinegar. If allowed to ripen in such barrels it must be transferred to protected barrels or to glass as soon as matured, or at least before acetous action occurs.

Juices of less strength, but of high flavor and low

acidity, may be strengthened with sugar to the requisite 14°, and in seasons of scarcity in the apple crop, when cider is like to command good prices, it may be found very profitable to do so, especially if at the same time sugar is low in price. The sugar may be applied at the rate of one and one-half ounces per gallon for every degree to be gained. Though not nicely accurate, this is very nearly correct, and is convenient for small additions of a few degrees. For great changes, such as to bring juice to the wine standard (22°), a pound of sugar in the gallon will raise the saccharometer 11½°.

Cider made from juice of less than 14° can not be kept in wood. Besides, it is flat and insipid, and scarcely worth making. It may be kept, however, in glass, if bottled and Pasteurized at the right stage, though it will rarely be worth the trouble.

It will be seen, from what has been stated, that immature apples, windfalls, and worm-ripened fruit, which never give juice marking 14°, can not yield cider fit for market. If there is a quantity of such fruit to dispose of it is best to feed it to stock, or, for want of stock, to make it into cider for vinegar or for distillation.

In the autumn of the last year the author recorded the progressive enrichment of the juices of apples as the season advanced. The following is the record:

	Per cent.		Per cent.	
12 September,	11	17 October,	14½	first flow.
17 "	11½	17 "	15½	middle.
19 "	10¼	17 "	15	last.
24 "	13	20 November,	14	
10 October,	13½	2 January,	16	

This record is neither extensive nor full, but it gives an indication of the course of nature in respect to apples. It was taken at a small but neatly-kept mill, run to supply so-called new cider (juice) to a restaurant making a specialty of that article.

It shows a general advance in richness with the season. The varieties of apples from which these tests were obtained were much mixed and uncertain, and the fruit was in an unknown condition as to maturity. In all probability they had received no exposure in the way of sweating, since they were bought in barrels in the New York city markets.

It will be seen that the first five juices—viz., those of the 12th, 17th, 19th, and 24th September, and 13th October—were all below standard, all being less than 14° by saccharometer. Those juices had very little of the ripe apple flavor, were all thin and watery, having more the quality of prematurely ripened apples than of the full, round richness of complete ripeness.

The French distinguish qualities of their cider by the ripening season of the apples from which the cider is made, into three grades, viz., "precocious," or petite (little) cider, from September fruit; ordinary or common, from October fruit; and grand (great) cider, from November apples. The precocious is weaker, less colored and less durable, than that of the next month, and the latter equally less than that from the last. The November cider, when from good fruit, is more spirituous, and can be kept four or five years.

One French authority, the Marquis of Chambray, asserts that "among all apples, it is only those which are sweet or bitter that are suited to produce good cider, especially if the sweetness or the bitterness is not very decided; that is, if the sweet is mingled with a little bitter, and the bitter with a little sweet. Apples a little sour render only juice which is colorless, poor, and ineffective, which has caused the remark that, 'it is with cider as with wine—it is good or bad, according to quality of the fruit.'"

Another French authority, Odolant-Desnos, holds that "it is rare that cider can be made from apples of one

kind"; meaning, of course, cider of satisfactory quality. Still another French authority, Dubief, controverts both the foregoing (as well as good sense), in saying, "It is true, and I will prove it, that all apples, sweet, sour, harsh, and bitter, make good cider, if it is well made."

This writer, though, has a hobby, which will be described further on. Doubtless good cider can be made from juices defective in saccharines, by supplying the deficiencies, but scarcely from those deficient in flavoring elements.

As to whether *the best* cider can be obtained from any one variety of apples or not is questionable. That is, it is a question whether there is any one apple giving a cider which can not be improved in spirituosity, flavor, or bouquet, by the intermixture in its juice of that of some one or more other varieties. Take, for instance, the crab-apple. Everywhere it makes good cider, the most spirituous and durable. Still, it is altogether probable that its flavor and bouquet can be exalted and enriched by the judicious blending of such high-flavored apples as the Spitzenberg and Seek-no-further. No other apple yields a juice so rich in saccharines as the crab, and if other juices are blended with it they should first be brought up to the same standard with sugar, so that the alcoholic strength may not be lowered by the intermixture.

In the general way the French say: "First, acid apples contain only meager juice; abundant, it is true, but producing cider without strength, of a flavor rarely agreeable, and which nearly always spoils; second, sweet apples furnish a cider, clear, agreeable enough, but insipid and without strength (of flavor); third, apples which are bitter and harsh to the taste give a cider strong, generous-bodied, rich in color, having, besides, the quality of keeping long."

Very few, indeed, are the American orchards which have been planted with reference to cider-making. It is therefore a matter of necessity that the cider of the United States shall be made of a mixture of varieties. The best thing that can be done, and the one thing that must be understood, in this situation, is for the orchard proprietor or cider maker to exclude from his cider all apples the juices of which are insipid, flat, or acrid, though up to standard strength, and also all of which the juices fall below, unless the latter can be brought to standard by the mixture with others sufficiently above, or with sugar.

The word "acrid," above used, should not be misunderstood. It is a very different property from "astringency," which is a characteristic of the crab and russet apples, and is altogether desirable.

CHAPTER VI.

STRAINING AND FILTERING.

The juices obtained from apples at the best mills are rarely, if ever, in condition for fermentation. The writer has never seen juice from a cider-mill in what he would call perfect condition. It always contains more or less parenchyma, and sometimes considerable pomace. If left in the cider during fermentation these substances enter into a species of decay, which has a very injurious effect upon the flavor and bouquet of the resulting cider. They contribute nothing but harm to the product. The more perfectly, therefore, they are removed from the juice before fermentation sets in, the more free the resulting cider will be from their deleterious influence. Fortunately, the introduction of press-cloths in all cider-presses of the present day has mainly removed the principal bulk of those substances, as compared with the condition of the juices of former days. Still, even the juices from the presses with cloths are not fully in condition to be fermented. They are barely tolerably clean, but are not perfectly so. They should never be allowed to enter into fermentation until they have been made quite limpid. It is the juice alone that makes cider, and if we desire to obtain perfect cider it is the juice alone we must ferment. Perfectly pure juice is perfectly transparent.

By reference to the chapter on fermentation, it will be seen that in the ordinary course of nature with fruit juices there are three successive stages of fermentation, known severally as the vinous, the acetous, and the putrid, and it should not be forgotten that all fermentation is decay. The vinous fermentation is no exception;

it is only the beginning, and if it be not checked at the proper stage the next stage will follow immediately. That next stage is the acetous (vinegar) stage, into which nearly all cider, and no small amount of ill-made or weak wines, pass. After that comes the putrid stage, in which the vinegar is destroyed, and nothing but corruption remains. Sometimes, though rarely, these successive stages manifestly go on simultaneously, or at least so overlap and pass on from one to the other as to lose all distinctive stages. Particles of parenchyma and excess of mucilaginous substances promote and stimulate the progress of these successive changes, and perhaps are a principal cause of the simultaneous occurrence of all those together whenever that occurs. It becomes, therefore, of highest importance to remove as much of that substance from the juice as can be done, as soon as pressed and before fermentation ensues. Set it down, therefore, as an axiom, that apple juice should never be allowed to commence fermentation until it is perfectly clean and transparent. There will then be nothing to begin unnatural or unwholesome fermentations, to impart their alien and disagreeable flavor to the cider.

To separate from juice the last remnants of suspended matters, the filter is the only effective means. In general, filters are only strainers of finer grade and more perfect action than the common article known by that name, and filtering is nothing more or less than straining. Filters are distinguished from ordinary strainers only by their more than ordinary closeness of mesh, and the more perfect cleansing that in consequence they make of the liquid filtered. Some are simple bags made of a thick and very compactly felted fabric. Others are made by employing some kind of fiber, such as paper pulp or cotton wadding, to diminish the size of the meshes or openings in a woven fabric, over which they are spread by the action of the current of liquid flowing

through, and with which they are mixed. By this means it is brought to lie quite compactly on the surface of the cloth, and presents only the minutest openings or pores for the liquid to pass through, so minute as to arrest all particles not perfectly liquid. Another kind which employs charcoal in powder has additional effect, not altogether mechanical, by reason of a certain affinity or cohesive power which that substance has for mucilaginous and albuminous materials, the which it withdraws from liquids in contact with it, and retains with tenacity. Apple juices have an excess of this material, which is a source of danger to the stability or keeping quality of cider, and which it is therefore desirable to remove from the juice as early and as fully as possible. For this reason charcoal filters are preferable for cleansing juices, though they are not admissible for cider, and the filter required for juices is quite different from that used for clearing cider and wine. The purpose now is mainly to remove the minute fragments of skins, seeds, and parenchyma suspended in the juice, and incidentally, also, a portion of the mucilaginous matters, and with as free access of air as may be easily procured, which at the present stage can only be beneficial so long as it is pure and untainted. The purpose, in filtering, after cider is made,—that is, at the close of the vinous fermentation,—is to clear the liquid of all suspended matters produced in fermentation, mainly cells of spent yeast, without exposure to the air, which at this stage is now a source of danger. The filters for the two purposes are usually different, though that for cider may be used for cleansing juice; but the common filter for juice is not suited for cider, on account of the great exposure to air its use involves. The filter for juice can be made by any one, but that for cider needs be made by a skilled mechanic.

The ordinary charcoal filter for juice may be made

from an ordinary cider or whisky barrel, as follows: Remove one head, and make a false bottom of it, thus: Cut away its edge until it will fit inside the barrel two inches from the other head; then nail some strips of tasteless hard wood, a quarter of an inch square, on one side, a quarter of an inch apart, until that side is covered; then between the strips bore quarter-inch holes through the head, an inch apart. Support this false bottom on blocks two inches above the other head, which now becomes the bottom. Through one stave, flush with the inside of the bottom, bore a hole and insert a tasteless wood faucet. Finally make a circular grating of inch by half-inch strips, placed an inch apart, and held by two or three of the same strips nailed crosswise. It should have a diameter a little less than the open head of the barrel, to go out and in freely. The filter is now complete, but is not charged ready for use.

To charge it, place first on the false bottom a stout piece of cloth of rather close texture. It must be large enough to turn up a couple of inches all around. On this place three inches of hard-wood charcoal, thoroughly burned, and pulverized as finely as bird-shot. Over this place another rather coarser cloth, and on this about four inches of sound, clean, well-washed rye or wheat straw. Press down on this the grating and slip it under some blocks nailed inside the barrel, to hold it down firmly upon the straw. The filter is now charged, but it is not yet ready for filtering juice. It must be washed first. Open the faucet and pour in water,—hot water, if you have it,—and keep water flowing through it until it issues *entirely tasteless*. When that occurs discontinue the water supply, but leave the faucet still open to drain. When the flow ceases your filter is ready for juice. The first flow, after turning in the juice, will be the water remaining. Put that in the vinegar barrel or throw it away. When the juice begins to flow in full strength

it should be limpid and bright; if it is not so, pour it back to filter over; it will soon begin to flow bright and clear, and is then clean.

For filtering cider and wine on a large scale, the fiber filter, sometimes known as the "Filtre Rapide," Fig. 14, is perhaps the best. It is for sale by apparatus-makers. It consists of a V-shaped hopper about three feet high, somewhat like an old-time ash leach, supported on posts. It is made tight, and contains two or more strainers or drums, of V-shape, to fit inside, but of only a foot or so in height. They are mere frames, about two inches thick, and the same width, made of hard wood. Each has six or eight slats of thin wood, of width equal to the thickness of the frames, into which they are fitted in notches, to stand in fan-like position from the V to the top rail. Over these are strained, by means of lacings, stout Canton-flannel covers, so drawn that no fluid can enter except through the cloth. Each drum has a quarter-inch tube of soft rubber from the top rail to and over the top of the hopper, for escape of air; also a block-tin half-inch pipe, very heavy, leading from the V downward through the bottom of the hopper, for escape of filtered liquid. With a couple of notched cross-pieces to fit on top of the drums and support them upright, and a board to hold them down by buttons at each end of the hopper, the filter is complete. The lath or board is pierced with holes along the space between the drums, and it is two inches nar-

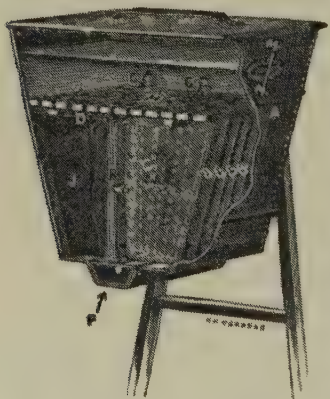


FIG. 14. FILTRE RAPIDE with one side removed, to permit the internal structure to be seen.

rower than the inside of the hopper, so that liquids to be filtered, when poured in, will be thrown away from the drums, and not wash away the fiber from their sides.

The size of the hopper, in point of breadth, is regulated by the extent of the manufacture. The capacity of the filter is increased by augmenting the number of strainers, which are usually placed about two inches from the sides and four inches apart; the smallest size, with capacity of ten to twenty barrels per day, having two strainers. From that the number may be increased indefinitely by augmenting the breadth of the hopper.

Generally the V is cut off a few inches at the bottom, making the hopper an inverted truncated pyramid. In either form the hole through the bottom must be bushed with India rubber to prevent leakage.

Use of this filter is made by means of paper pulp, with which the cloth strainers are thickened and closed until they are impervious to all things not perfectly fluid.

Paper pulp used for this purpose is nothing but ordinary French filter paper reduced by stirring, sheet by sheet, into a bucket of clean hot water until the requi-

FIG. 15.

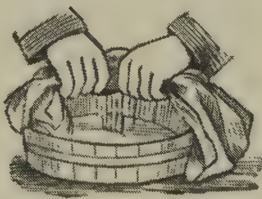


FIG. 16.

site quantity is obtained, usually about one quire to each strainer. When thoroughly pulped the mass is perfectly washed by repeated waters, from which the pulp is squeezed out until the water pressed out is entirely taste-

less. It is then placed in a stout cloth and wrung, by twisting, as dry as possible. (Figs. 15 and 16.) It is then mixed with sufficient of the liquid to be filtered to fill the hopper and carefully dipped into that. While filling the hopper the outflow pipe is kept closed, but is opened as soon as it is filled, and the hopper thereafter kept full of the liquid to be filtered.

It must be understood that all filters clog up sooner or later, if they are effective; that is, if they take anything from the liquid filtered; and that the more the liquid filtered is loaded with suspended impurities the sooner the filter will become blocked. It is therefore desirable to reduce the work to be done by the filter to the lowest amount by previous strainings through successively finer strainers. When paper pulp or cotton wadding becomes choked it may be washed and dried, and will then be serviceable again. It will not, however, become as good as new, and can not, ordinarily, be renewed more than once.

In filtering wine or cider with the "Filtre Rapide," attach a rubber hose to the outlet-pipe, touching the bottom of the receiving-tub to avoid atmospheric contact as much as possible. In large operations arrange to lead by hose from the supply cask to the filter and from the filter to the new storage cask, thus avoiding nearly all air contact.

Of whatever material filters are made, and in whatever way they may be constructed, there is one overruling requirement which must never be lost sight of, and that is, that while removing one impurity that another and different one be not imparted—and these all the more difficult to detect, because it is invisible after filtration. This is the objection to the use of sands and clays for filtration of either juice or cider. They are now much advertised for this purpose; but all alike are inadmissible, as they invariably are injurious to the quality of the

cider. Sand is rarely free from particles of lime, of iron, or of aluminous schist, and clay has always iron and alumina, and frequently lime in combination. It may be, and probably is, true, that with nearly all sands and clays used for this purpose the amount of impurities dissolved is not sufficient to produce a distinctly recognizable flavor, for that would lead to their instant rejection. Still, though not distinguishable, the effect is there, all the same, and though not to be named by itself as a distinctly disagreeable flavor, yet the general quality is depreciated, and the cider which has been treated with clay or filtered through sand is never, in any case, as good as the same which has been filtered through clean fiber only. Even sand made by grinding pure white glass to powder will impart an alteration to the wine filtered through it.

Another kind of filter, smaller and less expensive, though quite efficient, and suited to farm and family use, may be made as follows: Make a bag of heavy Canton-flannel (fiber inside) three feet long and ten or twelve inches diameter at the open end. Run a stout cord a quarter of an inch in diameter into the hem, with four or six loops exposed to hang it by. Hang this on a frame, under which place a tub, and on top of which may stand a barrel or keg containing the liquid to be filtered. This should be provided with a wooden faucet, appended to which is a small rubber hose six or eight inches long. The faucet should not be more than an inch or two above the intended surface level of the liquid being filtered, so that the fall may not produce much disturbance in the filter. This filter is to be treated with paper pulp in the same manner as described for the "Filtre Rapide."

The author has made and used another filter for small quantities which is quite simple and easy to prepare anywhere. It is also quite effective. A rather deep oaken

bucket, like a well-bucket, was bored through the bottom and fitted with a wooden spout, so that it could be used as a tunnel or as a filter as occasion required. Into the bottom of this three or four inches of clean-washed and dried cotton wadding were pressed quite firmly, and held down by two or three inches of clean-washed white quartz pebbles, the size of a pigeon's egg. It is necessary to be careful not to include among the pebbles any limestone, nor any showing presence of iron ore by its yellow or brown stains, as those would affect the juice unfavorably. With these in sufficient quantity to hold the cotton batting well compressed, filtration may be commenced, as with either of the other filters already described.

The effect of charcoal filtration of juice may be obtained with the "Filtre Rapide," the bag filter, or the bucket filter, by mixing finely-powdered wood charcoal through the juice to be filtered previous to filtration; but the charcoal so used must be thoroughly washed and dried before using for this purpose

HEATING OF JUICES.

Along with cellulose, there exists in unripe apples and in the incompletely ripened parts of partially ripened apples, a substance known to chemists as *Pectose.* By the ripening process, or under influence of heat and acids, pectose is changed to pectin. The sweet, gummy juice which exudes from baked apples is a thick solution of pectin. Fruit jellies are composed of transformed pectin. Pectose is not soluble in water, but pectin is, resembling starch in these changes, and, like starch, it is changed by contact of organic acid into saccharine. Of course it follows that if the ripening process of apples used for cider has not gone to perfect completion throughout every apple in every pile,—which perhaps never

occurs,—before they are ground, that there will be more or less unsaccharified starch, mucilage, and untransformed pectose in the juice. These substances appear therein as *mucus*, which it is the object of the charcoal filtration to remove before fermentation. If not so removed they are thrown to the top in the first movements of fermentation in the form of scum. The same substances appear on grape juice when pressed from grapes not completely matured, as are those used for champagne wine in France.

Along with these substances, in both cases, is much of the albuminous substance of the fruit, which, by its viscous nature, is entangled with it mechanically, and is thus carried to the surface. All these substances are foreign to a perfect cider or wine, and are especially dangerous to its stability, since the albumen contains nitrogen as an element. It is on this account that must for champagne wine is so carefully skimmed, prior to fermentation, a process elsewhere recommended for cider.

Dubief, a French writer on cider and wines, claims that heating the freshly-expressed juice of apples will change these substances into saccharines. The heat, he states, need not be carried very high, say to 160° F., or thereabouts, but needs to be held there during the space of about two hours. To carry it much higher would injure it by imparting a cooked taste.

There is good reason, however, to believe that great benefit to the quality of the cider may be obtained in this way. Imperfectly saccharified, starchy, mucilaginous, and gummy matters, and perhaps pectose and tissue, are likely to be converted to saccharines, thus increasing the proportions of that desirable substance; excess of albuminous matter will be likely to be coagulated and rendered harmless, and some concentration will accrue from evaporation of water, which is always in excess. Certainly no harm can accrue, and much good is likely to result from it.

Heating of juice must be made before the charcoal filtering, and positively without contact of iron, or, indeed, of any other metal than, possibly, block tin (not tin plate). Copper, tinned inside, and very clean, may serve, and porcelain-lined wares, in good condition, may do on the small scale, but on the large scale a steam coil of block tin in a hogshead or tank would be required. Even then this coil would be the better if silver-plated outside.

Possibly, after heating juice to the degree named, it might be found that the ferment had been killed, in which case a small portion of unheated juice must be added *after the heated juice has cooled to* 100° F., to supply that substance. In this event it were well the fresh juice were taken from carefully-selected specimens, since it is well ascertained that there are different varieties of ferment, producing different flavors and effects.

STRENGTHENING OF WEAK JUICES.

Supposing the heating and charcoal filtration both to be completed, now is the proper time to augment the saccharine strength of the juice by use of sugar. For this purpose no lower grade should be used than the best quality of granulated, styled "Coffee A." Whatever degree is desired will be attained by using one and one-half ounces per gallon for each per cent or degree of the author's saccharometer to be gained. This is for small differences; if the gain is a large one the sugar must be used at the rate of one and four-tenths ounces per degree. Thus, one pound will raise the saccharometer 11½°. It is to be remembered that this does not mean that so much sugar is to be added to a full gallon; but that so much sugar, with sufficient juice to complete the gallon. It will not make a perceptible difference, for small additions of sugar; but for large ones it does,

and must be allowed for. The proper way to add sugar is to dissolve it in a portion of the juice heated to near boiling, and then to pour it into the mass, while stirring the latter; otherwise the heavier syrup will settle to the bottom and remain there.

CHAPTER VII.

FERMENTATION.

The juice, having been heated (if that course is adopted), cleansed, and its acidity and saccharine strength adjusted to suit the intended purpose, is now ready for fermentation. From this on the process is identical with that for white wines from grapes; and a perfect cider will be somewhat like a perfect white wine. It must be fermented to complete dryness or hardness, and will then consist of water, alcohol, acids, glycerine, and extractives, but no saccharines and no ferment. With these are certain minute portions of various ethers due to the acids. "Whatsoever is more than these cometh of evil," and is very sure to be detrimental to quality. With all these in due proportion, and with nothing else, the soundest cider of the highest quality may be obtained.

The ordinary course, in the old-time method of making white wine, is as follows: The must, pressed out through straw, and perhaps roughly strained, but muddy with parenchyma and husks, is placed in barrels in any convenient place. In twenty-four to forty-eight hours it commences to "work," the first indications being the rise through the bung-hole of a frothy, mucilaginous

scum, characterized by large, persistent bubbles specked with yeast and parenchyma. This is called purging, and is different from the active "petillant" effervescence of real fermentation, which sets in immediately after. At the same time the temperature of the fermenting mass begins to rise above that of the surrounding atmosphere. This rise continues for several days, or a week or more, and until the saccharines begin to be weak, then the fermentative action slackens gradually, and the temperature falls until it again reaches that of the surrounding atmosphere. Soon after this fermentation ceases and the wine is dry. The saccharometer now marks 0°; a little more or less, according to proportions of alcohol, extractives, etc., and the wine is immediately racked off into well-sulphurized barrels, and placed in the coolest apartment available. The whole course of the fermentation consumes, ordinarily, from five to twenty days, according to strength of must and degree of temperature, light musts fermented in high temperature being terminated in the shorter period, and rich must in low temperature requiring the longer. When the fermentation is very active and appears to boil it is called "tumultuous" by the French, and "tempestuous" by the Germans.

In this condition of quiescence after fermentation it is allowed to remain some days to allow the grosser lees to deposit, provided no fermentative action re-appears. In case there is such continued action, the young wine is immediately racked again into freshly-sulphurized barrels; which operation is repeated daily until all action of that kind is completely checked, and the fermentation silenced. With several days' repose, after this, the bulk of the lees will settle to the bottom, and the young wine is then separated from them by again racking off. The sulphur fumes are now supposed to have killed the remaining ferment, so that it may be removed with the

last and finer portions of the parenchyma, altogether constituting the lees. For this purpose "finings," or "clarifiers," are used. They are animal substances, consisting mainly of gelatine or albumen, which, being nitrogenous, is very prone to decay, and if not entirely precipitated and removed are certain to induce putrefaction. They depend for their action on finding sufficient tannin in the wine with which to combine and form insoluble precipitates. Of course this removes the tannin also along with the fining.

After this has settled and the wine becomes clear and bright, it is again racked off from the last lees and stored away to ripen. At every racking the new barrel is more or less sulphurized.

The process has serious objections. It puts something into the wine which does not belong there; which is unnatural, unnecessary, and dangerous to its keeping quality and the purity of its flavor—viz., gelatinous and albuminous animal substances and sulphurous acid; and it takes from the wine a material which is necessary to its best quality and which should remain there, viz., tannin. Other means have been found to accomplish all the ends obtained by this process, means which are free from the objections stated, and which have the additional advantage of being both expeditious and certain in their effect, which can not be said of the process by finings, since the latter process requires delay—waiting for lees to settle; delays often quite protracted and dangerous.

If we consider the action of finings closely we see that it is both mechanical and chemical. It is chemical in combining with the tannin, and mechanical in the filtering which it effects of the fluid in which the combination occurs. The chemical effect is a necessary evil of employment of the undesirable material, in order to obtain the mechanical effect desired.

The dissolved finings diffused through the wine is rendered insoluble by combination with the tannin it meets there; and then it acts like a net, inclosing all substances not absolutely fluid, and, becoming weighted thereby, settles to the bottom. This part of the action is precisely that of the filter, with only the difference that in filtering the fluid passes through the net, while in clarifying the net passes through fluid.

As to the chemical effect in removing a part of the tannin, if that were desirable, as is sometimes the case with wines, though never with cider, it may be much more safely and easily accomplished after the filtering and silencing in Pasteurization than earlier. Successive small doses of gelatine or albumen will then reveal their effect in mollifying acerbity much more clearly than while the taste is obscured and masked by that of the suspended impurities.

The other means for accomplishing the clarification and protection or silencing of the cider relates, of course, more closely to that portion of cider-making which follows immediately after close of fermentation than to fermentation proper. As to the process of fermentation itself, no change is proposed for that other than to favor and promote its regularity and soundness by nicer observance of its requirements.

Fermentation is the one part of the process of the making of cider, as well as wine, which exercises the highest influence on the character and quality of the product. Whatever the quality of the fruit, the perfection of its maturity, the skill in blending juices, their richness in saccharines, and the nicety in proportion of acid, all will go for nothing if all the requirements for a safe and sound fermentation are not strictly observed and successfully carried through to the conclusion.

It is in the fermentation that most defective wines and ciders are spoiled. The requirements to be ob-

served are simple and easy enough, but they are also exacting and absolute, and can not be neglected with impunity.

First among them is right temperature; the second is steady temperature; the third is the termination at the proper moment; followed by prompt and complete defecation.

Among wine makers two kinds of fermentation—or, rather, two temperatures for fermentation—are known and advocated. Of course, both are within fermentation limits, but the one known as the "high fermentation" employs the degrees at the upper end, and the other, known as the "low fermentation," employs those at the lower end of the limits. Vinous fermentation will continue only very slowly and ineffectually at 50° F., or below, and not at all or unsoundly above 100° F. Low fermentation is that which occurs between 60° F. and 75° F., and high fermentation is that between 80° F. and 95° F. In wines, high fermentation is believed to yield more alcohol and less bouquet and flavor, and low fermentation less alcohol but more bouquet and flavor.

California wines, and those of all southerly wine-growing countries, are necessarily fermented at high temperatures, while those of the Rhine and of the Middle Atlantic States of the United States are fermented at low temperatures. The difference seems adapted by nature to the requirements of each climate, for the grapes of the warm climates are richer in saccharines than those of the temperate, and richer juices require higher fermentation to carry them through to dryness. In regard to cider, no experimental tests have yet been made, so far as known. There is, of course, a temperature which is better than any other, a golden mean, somewhere, that will produce a better average result than any above or below; but where that is is yet unknown. This point is one of those facts which would

be of great value to the whole country, but which, with many others of like importance in the art, should be determined by careful and repeated tests, made with all the care, deliberation, skill, and thoroughness which government alone can afford to bestow.

The French claim that tumultuous (high) fermentation, "impoverishes, and at the same time injures, the other qualities of cider."

It would seem as if there could be little reason to doubt that high fermentation, by its excessive temperature and its tumultuous effervescence, with the consequent rapidly-recurring exposure, throws off much alcohol, and probably all ethers produced during the stages of high activity; so that a wine so produced has less character and quality immediately after its close than do those fermented at lower temperatures.

Nature's purpose in the change we call fermentation in fruit juice "is the re-establishment of an equilibrium" among its elements, that which previously existed having been broken up by the separation of the juice from the cells of the fruit, and the introduction of a new substance, ferment, which, by reason of its vitality, has power to seize upon and use a portion of one of the elements, oxygen. It takes this from the saccharines, with the effect, heretofore stated, of liberating carbonic acid and leaving alcohol.

In going through this change there is a constant effort at purification. All the material present unsuited to the new combination is dropped, and in time settles to the bottom in the form of a sediment called lees. At first, while gas is beginning to be liberated, these substances, entangled with the mucilaginous, are lifted to the surface by the gas in the form of bubbles, carrying with it particles of parenchyma, if any have been carried into the juice.

This effort of nature to purify and throw off the dross

should be promoted and assisted by every proper means. If the fermentation is too tumultuous and rapid it will not be so easy to do this effectually, as in a more moderate and tranquil one. It was to effect this purification as far as possible at the earliest stage that heating of juice and charcoal filtration were directed. Still, even these leave yet some traces of impurities which it is necessary to get rid of.

That may be best effected by the method pursued in France, in the champagne district, in the fermentation of grape juice for champagne. The must, as soon as expressed, goes into large vats, or tanks, called "curves," where it is allowed to remain until the commencement of fermentation has thrown a tenacious, frothy scum to the surface. This is carefully skimmed off and removed as long as it continues to rise, which is usually until the tumultuous fermentation sets in. With the frothy scum goes a considerable quantity of the yeast known among brewers as "top-yeast," which has a bitter, yeasty taste, and had best be kept out of cider. When the frothy scum no longer rises to the surface, the juice, now in active fermentation, is drawn into barrels, which are not filled quite full, so that whatever rises to the surface thereafter will not escape by the bung but will fall back into the cider and remain there. This latter substance is principally "bottom yeast," and is necessary to complete the fermentation. The cider is now to be allowed to complete its fermentation in the barrels without escape of other material than the carbonic acid gas.

One very important precaution is to be observed, in following this method. The juice, in its transfer from the tank to the barrels, must not become chilled. If the temperature has become excessively high, say above 85° F., it may be reduced a few degrees, say five or six, but no more, by means of a previous rinse of the barrel with water of a proper temperature to leave the degree

desired. On the other hand, the same occasion may be availed of to quicken the movement of a slow fermentation not yet sufficiently warmed.

This champagne method is an excellent one for cider, where conveniences are at hand or attainable. Where this method is impracticable another one must take its place—the ordinary one of purging, as it is called, at the bung. It consists in filling the barrels, so that the frothy scum will flow out at the bung-hole. In this way the same result is partially, though less completely effected, since much of the matter which would rise to the open surface of an open tank is caught and held by the inside of the top staves, and can not reach the bung-hole. Still, sufficient of it does escape to make it desirable, in all cases, to use that method for cider where the curve method is not practicable.

Apple juice purged in the barrel must be kept filled by daily replenishment as long as purging continues. If good old cider is available it is well to use it for this purpose; but it must be entirely free from acetification.

In either method, as soon as the purging ceases the bung may be dropped *loosely* into its place, and the fermentation may be allowed to take its course until the saccharine is exhausted. It must, however, be carefully watched by inspection every few hours to see that all is going right, as well as to check and correct any wrong tendencies which may suddenly appear. This is called governing, or controlling the fermentation.

Inspections during fermentation should be made every six or eight hours with both thermometer and saccharometer tests. The observations and degrees of both instruments should be carefully recorded, with date; a memorandum page being kept for each cask or package separately. The page should be headed with the date, the blend or variety of apple from which the juice was pressed, and any other particulars special to that parcel

The acidity, saccharine strength, temperature at setting of mash, temperature of room, and all particulars should also be carefully noted. This heading, followed by notes of the successive inspections, gives, then, a perfect history of each cask from its start. After a year or two of practice and notes, with their successes and failures, such a note-book becomes a most invaluable guide, and the more full, complete, and minute it is, the more valuable the guidance it will furnish.

At the commencement of active fermentation the thermometer indications must be scrutinized most closely to see that the temperature is neither too high nor too low, though yet a little lower than the intended maximum; and that each successive observation shows no diminution, but rather a slight increment of temperature, steadily maintained, until about three-fourths of the saccharine is converted. After that the activity of the effervescence will begin to slacken, and with it the temperature will gradually abate, until, in a well-governed fermentation, the room temperature and complete dryness are reached simultaneously.

During the latter part of this period, if the temperature has moved satisfactorily through the opening and most active stages, and especially after the maximum activity has passed, the indications of the saccharometer begin to possess the keener interest. There is now no danger of an excessive or injurious temperature from internal action, but the danger to be guarded against arises from the continuation of fermentation beyond exhaustion of all the saccharines. In weak wines, supplied with superabundance of ferment, as with cider, an active ferment in a stimulating temperature, which has converted all the saccharines present, will turn at once upon the alcohol and convert that to vinegar, or partially so. It is therefore necessary to consult the saccharometer the more frequently and closely the nearer it sinks

to the danger line, the 0. When it touches this, or even before, if fermentation has ceased at a degree or two above it, the cider must be withdrawn from the fermenting casks, cooled as low as practicable, and be placed in the lowest attainable temperature.

During this period every precaution necessary must be taken to insure, in the fermenting room, a perfectly *steady* temperature, whether it be for high or for low fermentation. It need not be an absolutely level temperature; it is better that it should rise slightly, but uniformly, so that there shall be a small increase from the first to the last, and that the close will be a degree or two higher than the beginning. But it is imperative that there be the least possible amount of fluctuation. It is scarcely possible to prevent some wavering, but it should be confined to the narrowest limits, and must never be allowed to exceed five degrees. Fermentation itself raises the temperature of the fermenting mass, which always rises above that of the surrounding atmosphere. A slight increase of temperature of the fermenting room favors this natural action and is beneficial. Too high temperature has very disastrous effects. At about 105° F. it sickens and alters the ferment, producing ulterior fermentations, changing for the worse the whole character of the product, or even utterly ruining it.

When fermentation does not set in promptly it is usually due to want of a proper temperature. When that has been attained for some twelve or twenty hours and fermentation still lags, it indicates an insufficiency of ferment. Inadequate temperature may be promptly gained by heating a small portion of the juice up to a high degree and pouring into the mass, while stirring the latter briskly. Insufficient ferment is best supplied by use of a portion of juice from another cask which is in active fermentation. But the best means for accelerating fermentation in the earlier stages is by driving a

current of air into the bottom of the fermenting mass, by means of a pump. It promotes activity by furnishing additional ferment, since all atmospheric air, not artificially sterilized or filtered, contains ferment germs. It also augments the supply of dissolved oxygen in the liquid.

The same process may be used to raise or lower temperature a very few degrees, if desirable, provided the air to be used, while of the necessary temperature, is at the same time free from objectionable qualities. Under any circumstances it must not be taken from any tainted source, such as a cellar or an apartment used for cooking. The air of the fermenting room is usually overcharged with carbonic acid and deficient in germs, and therefore unsuitable.

It is to be remembered that weak juice ferments much more rapidly and terminates much more quickly than that which is richer. It is also more liable to pass quickly from the vinous to the acetous stage; hence must be watched more closely at all stages, and most particularly toward the close. It is in preventing this latter change that alcohol has such powerful preservative or antiseptic effect. Of course, such effect is proportional to the quantity present. A weak juice produces a weak cider, consequently the antiseptic effect is not sufficient to prevent further fermentative action, if active ferment still remains, with suitable temperature. As has been stated, acetification will not commence where the alcoholic strength exceeds 12%, nor where the temperature is below 48° F. to 50° F. For these reasons wine is always safer than cider in the same temperature, and cider is safer in winter than in summer. Whatever the character of the fermentation, whether high or low, the temperature must be kept, in all cases, within the limits of 60° F. and 90° F., observing, however, that rich juices require higher temperature than poor.

When juice has gone through the vinous fermentation satisfactorily and has reached its close, so that it has become necessary to prevent further action of that nature, the next step is to cool it below the fermenting temperature. This is best done by racking it off through a block-tin coil immersed in ice-water, or even of very cold spring-water. The latter will require to be kept cool by constant renewing. A few handfuls of common salt dissolved in water helps its cooling powers. The cider should flow from the cooler into barrels which have been thoroughly cooled by rinsing with ice-water or cold spring-water. These means will reduce the temperature promptly below the fermenting point, and nothing further need then be feared from that source until returning warmth restores activity to the remaining ferment.

Before that can occur it should be devitalized, and thus the last danger from that source be removed. Preparatory to this it should first be cleansed of all the refuse and rejected matter then held in suspension. However transparent and clean the juice may have been when the fermentation commenced, it is now, at its close, turbid, and though possessing all its alcoholicity, is still without vinous flavor, but has, instead, usually a rather yeasty taste from the remainder of that substance still present.

The turbidity comes mainly, in a juice previously well cleansed, from the cells of spent yeast suspended and slowly settling therein. These, with the surviving germs, and in uncleansed juices the remnants of parenchyma, constitute a source of danger, and the sooner they are separated from it the less harm will follow. For this the fiber filter is the efficient and ready means. The ancient usage was to make use of clarifiants or finings for this purpose. The objections to their use have already been stated, not the least of which is the

delay waiting for the lees to settle. The filter requires no such suspense. As soon as cooled, and the sooner thereafter the better, all these impurities may be, as it were, combed out of the cider, to the last vestige, and without putting into it anything to prejudice its quality or stability.

Immediately after the filtration should follow the destruction of the remaining ferment, by Pasteurization. That done, our cider is made, and now is safe. Nothing can harm it but neglect. It is not yet ripened, and has not yet attained its quality. That comes only by time, but it comes much quicker, more purely, and perfectly, to a cider or wine thus withdrawn and sheltered from all the ordinary sources of contamination, than to those not so protected and advanced.

CHAPTER VIII.

PASTEURIZATION.

It has long been known that fermentation is stopped, as well as prevented, by heating, with after-exclusion of air. Living ferment germs, in alcoholic liquids, are devitalized by a lower degree of heat than is necessary in liquids without alcohol. The degree necessary with wines depends upon the proportion of alcohol present. This is the discovery of Pasteur, and the systematic application of this principle to the preservation of wines is named in his honor, Pasteurization.

The preservation, or rather protective action, of heat on wines was well known long before his day, but he investigated the facts systematically, and established the

application of the method on a scientific basis. Before that all was confusion and uncertainty. No one knew what was the necessary degree of heat, nor how long it should be continued. Much wine was lost for want of such information, by trusting to insufficient heating, and very much more was destroyed by overheating. Pasteur's investigations cleared up all these points and fixed the limitations of the temperatures, as well as ascertained the precautions to be observed to attain successfully all the benefits which may accrue from the process; benefits which extend beyond the mere destruction of ferment germs and the consequent sheltering of wine or cider from fermentative action.

He found that it not only did all that, but that it had also the effect of two years' time in ageing or ripening wine subjected to the proper degree at the proper time. This fact, which is now everywhere admitted, facilitates the tedious and expensive time process of ageing, and saves the delay, expense, and hazards attendant upon carrying a stock of wine for that much of its maturing stages, so that a wine a year or two old, subjected to Pasteurizing, becomes at once as soft, mellow, and generous in quality as the same wine at four years without, and is, besides, protected from all possible harmful effect of remaining ferment germs.

Nor do these benefits, ample as they are, include all the advantages which may be obtained from its application. Juices in their vinous fermentation taking unfavorable tendencies, and young wines assuming a prejudicial quality, are at once put to shelter from any further untoward action, and, in some cases where damage has actually accrued, are restored to a sound and agreeable condition by the process. Juices starting in an unsound fermentation, Pasteurized and filtered, can be used with new juices in a new and sound fermentation, and thus be saved from the utter destruction which would otherwise be certain to follow.

The precautions to be observed for successful Pasteurizing are few and easy. They consist in: First, keeping the heat steadily within the limits of temperature fixed by M. Pasteur—140° to 160° F.; second, restricting the duration of the exposure to the highest heat to a very few minutes; and, third and most important, rigorous protection from touch of atmospheric air during the whole process, and thereafter, till cooled and stored again in barrels.

The latter precaution is necessary to prevent escape of alcohol and of bouquet.

Pasteurized wine tastes a trifle flat at first, in consequence of loss of carbonic acid. It soon recovers from that without treatment, but if it becomes necessary to restore it without delay it can be done by leading a current of carbonic acid to flow into the cask at the bottom of the wine after the wine is cooled. It will be absorbed promptly, for which reason care must be taken not to use too much. It is better, however, to replace the atmospheric air of the receiving cask by carbonic acid before leading the Pasteurized wine into it. It is easily done from a cylinder of liquefied gas, and the taste of the Pasteurized wine will then be perfectly natural.

Pasteurizing is now of almost universal use in all wine-producing countries. It has largely superseded sulphurizing, and with the filter, which has largely supplanted the use of finings, has very greatly benefited and improved the wine product of the world, as well as removed the greatest danger and most frequent source of loss in the process of wine-making.

Numerous inventions have been made in France, and some in the United States, for Pasteurizing. They are mainly for the treatment of large quantities, for which they are arranged to work continuously. Where this form is used the casks of wine to be treated are placed at an elevation of five to eight feet above the Pasteurizer,

so as to produce a pressure therein of two and one-half to four pounds per square inch. From the cask the wine is fed down by a pipe of small size to the Pasteurizer, whence, after a stay of short duration, sufficient, however, to raise it to the required degree, and to hold it there a few minutes, it passes into a cooler, and thence, when cooled, by another pipe (usually a hose) into the storage casks, in which it is then hermetically inclosed. The hose is carried quite to the bottom of the storing barrels, so that the wine issuing therein will not be exposed to fall through atmospheric air, in reaching the bottom, as it would if the hose terminated near the top. The same purpose may be best accomplished, and the slight flatness before mentioned removed, by displacing the air of the cask with carbonic acid before the Pasteurized wine or cider is run into it, as before described.

Pasteurizers are usually made of tinned copper, the tinned side only having contact with the wine. The larger ones are commonly heated by steam; but some are made to be heated by hot water. In both kinds cooling is done by a current of cold water flowing through a second member of the apparatus similar to the first. Both heater and cooler are of equal size, which is sufficient to compel the wine to be a certain length of time therein, in order to acquire, and again to lose, the required temperature while passing through, so that it issues cooled to the proper degree. In this way it loses no alcohol or perfume. Temperatures in both are shown by thermometers suitably fixed to each part.

Other forms for more limited establishments are made of block-tin pipes. A small pipe leads from an elevated wine cask to a coil of larger-sized pipe within an open boiler, under which is a small furnace capable of giving a moderate but steady heat. The outlet of the latter

pipe is provided with a thermometer, to show maximum temperature of the wine, and is connected to another coil within a tub filled with cold water for cooling, whence it is delivered, as in the preceding. The cooling water must be constantly renewed. In all styles the flow, both into and out of the heater, is regulated by stop-cocks, which admit of controlling the movement with precision.

For lesser undertakings, like those of the farm and household, it is sufficient to so arrange a barrel of cider, or half a dozen or more of them, in an apartment which can be closed perfectly tight, and provided with means of producing and maintaining an odorless temperature of the required degree, as well as of maintaining it for a space of some hours, to make sure that the heat has been transmitted through the wood and communicated to the cider.

In this latter method it is best to have a thermometer passed through a stave of one barrel (a fluid thermometer will do), so that the temperature of the cider may be read at all times. It is also necessary that the barrels be quite strong, well hooped, and very securely bunged. And they must *not* be filled quite full (say by one gallon in fifty), since the wine or cider will expand by heat. After being held at the proper temperature a suitable length of time they may be cooled in any convenient and prompt manner,—wetting the surface is very good,—but they should not be moved until thoroughly restored to natural temperature.

Still smaller quantities may be Pasteurized in bottles. The wine or cider, in this case previously filtered perfectly bright, is drawn into clean, stout bottles, each filled to an inch and a half below the cork. The bottles are then securely corked, and the corks driven home and wired or tied down. They are then placed, corks down, in a kettle of sufficient size, and the intervening

spaces filled with cold or tepid water. The kettle and contents are then placed upon a stove, range, or furnace to heat. When the temperature of the water has reached the required degree it is allowed to stand there a few minutes (fifteen or twenty), and the kettle and contents are then removed and allowed to cool, after which the bottles are removed and stored on their sides. This was the method used by Pasteur in all his investigations.

RIPENING.

By this term is meant that change in the quality of wine and cider which accrues after completion of the vinous fermentation. It is usually called the slow fermentation, or the after fermentation, probably for want of a more exact term. It involves no measurable change in the elements, such as occurs in the latter act. But it seems, rather, to be a slow formation of ethers by the prolonged contact in close confinement of the alcohol and acids of the wine or cider, with perhaps a partial oxidation of some alcohol.

Whatever it may be, it is essential to the completion of the cider, which, at the close of the fermentation, silencing, and filtration, has neither vinous taste nor bouquet, both of which it acquires by this process. It is best effected in wood, in barrels not varnished or coated, but very carefully closed and kept constantly filled very close to the bung. The latter should be driven in lightly, and had best be of extra length *outside the stave,* so as to be easily removed without disturbance of the contents. Many writers recommend the use of a stout cloth wrapper around the bung to seat it firmly, and still give exit to the carbonic acid, of which a little was yet produced under the old method of treatment. The cloth is disapproved by the writer, because if wet by cider or by condensation it becomes a ready means of

acetification, and of transporting that action into the barrel.

If cider or wine, in which all vinous fermentation has been terminated by complete devitalization of all ferment, be placed in barrels, without exposure to air, no carbonic acid can be produced and there will be no need to provide for its escape. So far as that is concerned the cask might then be hermetically sealed. But the wood is porous, and there is slow evaporation through it. The wine so evaporated must necessarily be replaced by air, which finds its way in through the same channels or around the bung. In addition to this there are slight dilations and contractions of the liquid under influence of alternations of external temperature, acting somewhat like animal respirations, by inhaling and exhaling air. Against the effect of these it is necessary to guard, and hold it at a minimum by keeping the cask constantly filled close to the bung.

The removal of the bung for this purpose and the use of wine or cider to refill with which has been exposed to contact of air, carries, necessarily, within the barrel minute portions of ferment, which soon again produces an insignificant but desirable portion of carbonic acid. And it is supposed, also, that the wine and the air meet together in the pores of the wood under conditions of diffusion over large surface which greatly favor partial oxidation into aldehyde; and that this, with the formation of ethers of the various acids, all contribute together to bring about those results which are attributed to the so-called slow fermentation.

Whether this be the true explanation or not, ripening is a change which has to be waited for. It comes more quickly to light wines, and consequently to cider. than to strong ones, and it is hastened by moderate heat continued several days, provided the heat is applied with perfect exclusion of air, and without escape of the

ethereal products. It comes, also, more early and more perfectly to wines from cleansed juices, which have been promptly filtered and Pasteurized at termination of the vinous fermentation. With all these encouragements, it will still be from one to two months in fully declaring itself, after which it will continue to augment slowly for an equal period. After this, that is, after it has become fully developed, it may again be Pasteurized for age, but it is quite as well to defer this until it is to be shipped or delivered for consumption.

To promote arrival of vinosity by heat the packages should be kept in a temperature just above fermentation limit—about 110° F.—for ten days. During the whole of this time, and thereafter until thoroughly cooled, it must be kept hermetically sealed.

As soon as it has fairly declared itself cider and wine of low strength, must be transferred to protected wood or to glass, in order to exclude absolutely all further access of air. Cider made from juice strengthened to wine standard may be kept in wood several years, but that of ordinary strength can not be depended upon.

Vinosity and bouquet having been fully or fairly attained, the cider must now be protected against further progress in that direction. It is better to be too early with the preventive measures than too late. The indications of the latter are less vinous or winey taste, and sharpening of the acidity, denoting the increase of acetic acid, though the latter may not be distinctly distinguishable.

The most effective means to prevent over-maturing is to transfer the cider to protected barrels or to glass—the latter being preferable—so that it may not be able to obtain more oxygen, the altering element.

The method of preparing barrels is by an external coat of hot—very hot—rosin or beeswax, or by an internal coat of hot paraffine. Whichever is employed, care

must be taken to see that the surface to be coated, whether inside or out, is not only perfectly dry, but is also as warm as it can be made by any available means; and the paraffine used interiorly must be pure, and especially free from stearine, with which it is often adulterated, and which would impart a disagreeable taste to the cider. Pure paraffine is insoluble in wine and cider, and tasteless.

Our cider being now made, it will be useful to review the process and see what the various steps are. They are as follows, viz.:

1. Harvesting the apples by means of harvesting blankets, to avoid injury and filth.
2. Piling on boards, rails, stalks, or straw, to avoid earthy flavor.
3. Sweating to last degree of ripeness, to augment saccharines and diminish water.
4. Testing fruit before mixing, as to saccharines and acidity, in order to avoid worthless fruits, and to blend valuable ones most intelligently.
5. Mixing varieties, by results of tests, to exalt and heighten quality.
6. Milling, in mill free from taint, and pressing through press-cloths.
7. Heating juice, to augment saccharines, and incidentally to promote clarifying.
8. Filtration through charcoal, to cleanse and to remove mucilaginous and other impurities.
9. Strengthening juice with sugar to standard strength or above, to produce requisite alcohol necessary to insure permanency.
10. Fermentation, with skimming or with purging, and in even temperature, to complete dryness.
11. Check of fermentation at dryness by cooling.
12. Filtration through fiber while cool, to remove waste products of fermentation.

13. Pasteurization to destroy ferment remaining.
14. Developing by heat to advance ripening.
15. Ripening, with semi-weekly inspection and refilling.
16. Transfer to protected wood or glass.

It will be seen that the process described differs materially from the old methods hitherto in general use. The whole of this process is one of steady purification and refinement. Everything which nature rejects, or which impairs keeping power, is removed from the juice at the outset, and all the efforts of nature in making the change from juice to cider are aided and promoted. Absolutely nothing is put into the juice, especially nothing possessing in itself disagreeable or degenerative qualities. The deficiencies of unfavorable seasons are amended by addition of small though sufficient quantities of saccharines, and the juice is brought to a standard, so that dependence can be placed upon the quality and durability one year as well as another. By all these the uncertainties attending the old method are well nigh extinguished. The process, besides, has been shortened in point of time, for though the manipulations are more numerous, they call for very little labor, and can succeed each other very rapidly. All the periods of waiting for settling or clarifying used in the old process are avoided.

CHAPTER IX.

OLD METHOD OF CIDER-MAKING.

For those who, for any reason, may prefer to follow the old method of making cider, the following are the successive steps. We will assume that the juice has been pressed,—not through straw, but through cloths,—and is therefore reasonably pure, and certainly free from visible fragments of apple. We will assume, further, that it has been made with a mill and press, as well as utensils, thoroughly free from mustiness, sourness, and all uncleanliness, and has been placed in barrels of like purity. It has not been filtered, nor has it been skimmed in the vat or tank, and therefore contains all the original proportions of albuminous matter, as well as all those particles of parenchyma which were fine enough to pass through the press-cloths. These substances are stimulants of fermentation, and the tendency of such juice, placed in favoring temperature, will be to rush through the vinous fermentation and into the acetous with rapidity, the acetous commencing, perhaps, before the vinous is completed. It is, therefore, important to restrain this exuberant tendency by making use of a lower temperature than that which is admissible, or even desirable, for fermenting properly cleansed and purified juices. The difference in temperature will be from five to ten degrees lower for this method than for the other. That is, the temperature best suited for uncleansed juice will be from 65° F. to 75° F. But it is equally as necessary with this as with the other, that the temperature of the fermenting room, whatever the degree may be, be kept free from fluctuations, and uniform or just barely rising.

The English have a practice of restraining this ten-

dency to ferment by racking off the cider several times during progress of the vinous fermentation, and whenever it seems to be getting too "tempestuous," into barrels *very lightly* sulphurized. The practice is not a good one, although perhaps less hazardous in their climate than in ours. It, of course, destroys some portion of the ferment; but the racking process exposes the liquid to take more germs from the atmosphere, and at the same time gives the alcohol already formed the most favorable conditions for acetifying,—viz., diffusion, while extremely diluted, to wide contact with the air. This is the most favoring condition for vinegar-making.

If it were deemed desirable to tone down the excessive action of the ferment it would seem, to the writer, a better method to sulphurize rather highly a small quantity of the cider withdrawn for that purpose, and then return it to the barrel without racking. This method is to be received as a suggestion only; the writer has never tried it.

The juice, having been carried through the fermentation to, or nearly to, dryness, the further progress must be arrested. The old method is by sulphurization with the fumigator, as described under the definition and description of that instrument. A clean barrel having been thoroughly sulphurized, the young cider is racked into it, and the empty barrel cleaned, sulphurized, and used for racking the next. If no other is yet ready to be racked, then the sulphurized barrel is carefully bunged and put away until required. The racked barrel may now replace the emptied one in the fermenting room. It must be filled and kept full to within an inch of the bung, and be examined three or four times during the first twenty-four hours after racking to see that no further fermentation occurs, and daily thereafter until it has been clarified. If fermentation recommences it may be ascertained by holding the ear to the bung-hole,

when the low hissing sound of the bursting gas-bubbles will be heard, also by holding a blazing match or splinter of wood in the bung-hole, which will be immediately extinguished by the carbonic acid gas. If it is found to be in action, sulphurizing by racking into a sulphurized barrel must be resorted to at once, and the same course must be repeated as often as fermentation is detected. After two or three repetitions of the process there will be no further trouble from that cause, and the cider will become quiet and will begin to settle and clear itself. Soon the grosser lees will have settled to the bottom. From these it must be again racked off. Then, and not till then,—that is, *not until all fermentative action has been checked*, and the gross lees been removed,—is the time to clarify.

Clarification is a process which requires, as a condition of success, perfect quietness or repose of the fluid clarified. If clarification is attempted while fermentation continues, however small in amount, the bubbles of gas which form in the fluid will rise to the surface, and so keep it constantly in motion, and there can be no settlement. But that is not all, nor is it the worst. The substances used as clarifiers are all albuminous, animal substances, and are exceedingly prone to putrefy. Isinglass, fish-bladders or sounds, gelatine or glue, fresh blood, milk, and eggs, are the principal clarifiers used. They all depend, for their action, on their meeting sufficient tannin in the juice to solidify them so that they become heavier than the fluid, and settle therein to the bottom. In solidifying and settling, or precipitating, they act as a net and carry all suspended particles down with them, leaving the fluid clear.

If, unfortunately, fermentative action is not entirely extinct when such materials are introduced, they not only do not precipitate, but they are liable to become involved in the fermentative action and to set up a spe-

cies of fermentation of their own, and taint the whole with a nauseous and disagreeable flavor indicative of danger.

The same thing occurs when the tannin present is not sufficient to solidify all the clarifiers used. A portion then remains unprecipitated, and is certain to putrefy in a very short time. This sometimes occurs when the first clarifying process, having failed in consequence of continued fermentation, and sulphurizing has then been again resorted to, with repetition of clarifiers, after silencing the remaining ferment. In that case there is rarely sufficient tannin to precipitate all the clarifier, a portion of which remains unprecipitated, destroying the cider.

Serious as are all these hazards and difficulties attending the old process by means of animal substances, still when they have all been successfully practiced, and perfect limpidity been attained, by apparent precipitation of all the clarifier as well as of all suspended substances, there yet remains, under all circumstances, a certain part of the clarifier mingled with the cider. The substances employed are not altogether and absolutely pure albumen nor pure gelatine. Take the white of egg, or milk, for example; coagulate them in any way, and there will still be a fluid residue unsolidified and foreign to cider or wine, and which ought not to be in those beverages. Fish sounds, and isinglass, which have been dried, have only lost their watery parts; the serous part, which was dissolved in the water with the albumen or gelatine, still remains, and redissolves as soon as do those parts, re-constituting the same condition which existed before those substances were dried. And when their albuminous or gelatinous portions are precipitated these residuary substances remain the same as though they had been used fresh and undried.

We will suppose, however, that clarifiers of one or the

other kind mentioned have been used, and that successful clarification has been obtained. This should always be accomplished by the first of January following the harvest. As soon as the cider appears perfectly limpid and bright it must be racked again into clean, recently sulphurized barrels, filled to within an inch of the bung, and must be kept so filled constantly thereafter. At the same time, if cider is to be kept in wood during the ensuing season, the casks must be coated with hot beeswax or rosin, to render them impervious to air. They should also, at this time, be stored in the coolest apartment attainable, and set up where they are to remain permanently; but they must still be accessible singly, so that they can be inspected at regular intervals, especially in the early spring and during hot weather, and can be filled up or removed, if any need be, for treatment, without disturbing others. They must also be bunged air-tight with a bung projecting an inch or more outside the staves, for convenience of removing without pounding on the stave.

Inspections and filling must be very frequent and thorough. The examination will consist in removing the bung with as little disturbance as possible, and smelling immediately at the bung-hole to detect any odor of vinegar or other improper smell, followed immediately by throwing sufficient light within the barrel, by means of a reflector lamp or otherwise, to see that there are no flowers (white scum) forming on the surface of the liquid. In case either is noticed immediate action must be taken if the cider is to be saved. If the odor of vinegar is perceptible the flowers are sure to be seen, as they precede, by several days, the formation of vinegar, and are said to be the immediate cause of it. If there are flowers without vinegar smell simple racking into well-sulphurized, clean barrels will be sufficient; but if vinegar has begun to form care must be taken to avoid

drawing off the upper or top strata, one or two inches in depth, in which all the vinegar is first formed. This will amount to several gallons ordinarily, which may go with the well-strained lees into the vinegar barrel.

For refilling barrels a sufficient stock of cider must be kept in well-corked bottles, and barrels should never be drawn upon for that nor for daily consumption. Neither cider nor wine, unless fortified by sufficient spirit to make it unfit for a beverage, will withstand the exposure incident to drawing from a barrel for daily use. Before the cask is half emptied the air entering to replace the fluid withdrawn will have converted the remainder into vinegar. The proper way to provide against this is that employed with wines in all wine-drinking countries. A sufficient number of bottles to empty a cask, or kegs enough to do the same, with bottles to empty one keg, are provided. Then a barrel is racked off altogether at once, into bottles, or into kegs and bottles. After that, when all the bottles are emptied, they are washed, drained, and refilled by drawing off another keg or barrel. A fifty-gallon barrel requires two hundred and fifty ordinary bottles to contain the same quantity. A half-barrel and one hundred and twenty-five bottles will contain the same.

In corking bottles the best method is to drive the corks dry, without soaking, but with wetting in a mixture of equal parts of glycerine and cider to lubricate them and facilitate entrance. The corks are first to have one end squeezed in a common cork-compressor, such as druggists use, so that they can be entered in the bottles a quarter inch or more. This is done before wetting them, and each bottle is to be fitted with its special cork, entered and left in the bottle till ready to fill, then the cork is withdrawn, the bottle filled to within an inch of where the bottom of the cork will be, and the cork is then dipped about three-fourths of its

length in the lubricator and at once driven home with a short flat club. It is then tied down with twine or wires, or both, and laid upon its side on the cellar bottom or other cool place, in which position the cork will be kept constantly wet and swelled tight. By driving the cork dry, advantage is taken of the subsequent swelling to obtain more effectual closing of the bottle than would obtain if the corks were first soaked and then driven, as they would then have to be, through a hand-corking machine.

Of the several clarifiers used in the old method, the best, undoubtedly, is the Russian isinglass, where that can be obtained genuine. It is said to be made from the sound or swimming-bladder of the sturgeon caught in the Caspian Sea, the Don and the Volga rivers. It comes principally from the ports of the Black Sea. There are many imitations of it in use, and some so closely resemble the genuine as to be indistinguishable from it, except by experts. It may always be obtained of the larger importing drug houses of the seaports. It costs from five to ten dollars per pound; but no more than a quarter of an ounce is ordinarily required for a fifty-gallon barrel. That, at ten dollars a pound, is fifteen cents per barrel, or thirty cents per hundred gallons.

Next to the genuine Russian isinglass comes the Cox and the Cooper's gelatines, put up in two-ounce packages, and sold by nearly all grocers for domestic use in making jellies. Finally, and last to be recommended, is the ordinary refined gelatine in thin, net-marked sheets, sold by grocers and druggists by the ounce, and used for the same domestic purpose. The other clarifiers mentioned, viz., eggs, milk, blood, and fish-sounds—the latter much used by large cider manufacturers—are, in the judgment of the writer, inadmissible when the others can be obtained. The whites of eggs *perfectly fresh* are less objectionable than blood, milk, and fish-sounds.

When either isinglass or gelatine is to be used it must be properly prepared. After weighing out the required quantity of Russian isinglass at the rate of one-half ounce per hundred gallons, it is first to be thoroughly crushed by pounding with a hammer on a stone or metal surface until the tissue is well broken down. It must then be soaked for two or three hours in a portion of the liquid to be clarified, during which it will swell up to many times its original size. It is then to be worked up with the hands into a uniform pasty mass, more cider added, and the whole allowed to soak again for two or three hours, after which it is again to be worked with the hands, and so on alternately soaking and working until all lumpiness has disappeared, and the whole becomes a uniform thick fluid. All this must be done at ordinary temperature, without warming and without heat, after which it must be passed through a fine sieve. It is then ready to be stirred into the barrels of cider. Taking out the proper quantity for one barrel, if preparation has been made for a number, a little of it is poured in at the bung-hole, after the contents of the barrel have been put in motion with a paddle or rouser. It is then to be thoroughly stirred or the barrel shaken, so as to insure its being equally distributed through the contents. More is then added, and again stirred or shaken in, and so on, alternately pouring in, then shaking or stirring until the whole portion for one barrel has been added to and thoroughly commingled with the contents.

The rouser spoken of is a bundle of natural straight twigs or of rounded splints, of elm, hickory, or other tough, tasteless wood, compactly tied in a bundle as large as will go easily into the bung-hole. The splints are usually about a quarter inch in diameter and two feet long; the cord binding closely wound around one end and extending down about six inches, leaving the other ends free. They naturally spread apart when passed

through a bung-hole, and act on a large quantity of the contained fluid at once.

Gelatine is more easily reduced than isinglass. It must never be used if it manifests, at any stage, a disagreeable odor. It needs only to be soaked and worked, and to be strained when thin enough, to which it yields much more easily than does isinglass. Once reduced, it is to be mingled into the contents of the barrels in the same way as stated for the isinglass. Where eggs are used the whites are the only part taken. They are broken one by one, to prevent taint from a stale one, the yelks are separated and put aside, and the whites beaten up with a sufficient portion of the cider until the coagulation has given away, and the whole become a uniform fluid, which must then be strained and stirred into the barrels, as directed for the others. About a dozen fresh eggs per hundred gallons are sufficient.

The clarifier having been put in, the barrels must now be refilled, the bungs closed air-tight, and the cider left undisturbed to settle. Daily inspection must be made, however, to see that all goes right. As soon as the cider proves to be cleared and bright, it must be racked from the lees carried down by the clarifiers. These will usually amount to several gallons from each barrel of fifty gallons. If there are many barrels the lees from all may be strained and put together into one barrel, where they will again settle and become bright, so that by drawing off there will be recovery of a considerable quantity of cider, but the portion so recovered will never be as good as that which was first separated from the lees, and should never be mingled therewith. The final residue of lees goes, of course, to the vinegar barrel.

BARRELS NEW AND OLD.

Barrels are made exclusively of oak in this country, so that the following directions may be understood as referring to those of that material.

New barrels will infect any alcoholic beverage kept in them with a taste of wood. They must therefore be deprived of that quality before they are fit to receive cider or juice to be fermented into cider. Where steam is at command the injection of a current is the most effective of all methods for purifying, not only new barrels, but also old ones. By its condensation on the whole inner surface it reaches every fiber and crevice and washes it with water hotter than any which can otherwise be introduced. Where steam can not be had the next best method, perhaps, is to fill the barrel with water and then to drop into the bung-hole lumps of quick-lime to the amount of about one quart. These will at once water-slack and form a warm caustic lime-water, which will combine with and neutralize the tannin, the active distinctive flavoring material of new oak wood. After soaking in this two or three days it may be removed, the barrel rinsed, and again filled with clean water containing about a pint of salt. After twenty-four hours soaking in this the barrel should be emptied, rinsed, and then soaked for ten or twelve hours in clean water. It is now ready to receive made cider or new juice to ferment. It will not now impart any alien taste.

Old barrels are to be treated differently. If they are musty and show mouldy spots and patches about the bung, "visit" them, as the French call it; which means, inspect the interior by fastening a wax taper—one of the children's Christmas candles—to a wire, and let it down inside so as to light it up within. If patches of white or yellow mould are visible inside it can not be cured, except at greater expense than the price of a new one. If free from interior mouldiness and not musty in smell, it may be cleansed and fitted for use. Steam stands first as a means. Next to that is hot potash (not soda) lye. This may be obtained everywhere in the

country where wood fuel is used, by leaching the wood ashes and concentrating the lye obtained by boiling. When it is strong enough to float a fresh egg pour five or six gallons boiling hot into the barrel, bung it closely, roll and shake it about, standing it on each head occasionally for a few minutes, until the hot lye has soaked and penetrated every crevice. Then pour out all but a gallon or so, and fill with clean water to the bung, which must be allowed to stand for a day or so. The barrel then emptied, carefully and thoroughly rinsed and drained, is ready for use.

Where wood ashes are not attainable they may be replaced by crude potash, kept at most drug stores, or, failing in that, by carbonate of potash (not soda), sure to be found in all such stores. The crude article needs no preparation except dissolving in water to the requisite strength, but the carbonate must be rendered caustic by adding to the water in which it is dissolved about half as much quick-lime, after which it should be allowed to settle and be poured off from the lime, and then used of the proper strength and heat. The reason for being particular to obtain potash instead of soda is that the former is a constituent element of all fruit juices, as well as of wood, and any trace of it remaining in the barrel does no harm to the cider subsequently placed in the barrel; it only neutralizes acidity and softens the cider or wine. Used in the caustic state recommended above, it is very destructive to any mould or vinegar germs which may come in contact with it.

Wood-ash lye or caustic solution of potash should be constantly kept in all cider- and wine-mills and cellars or storage rooms. All vessels, cloths, apparatus, and utensils should invariably be rinsed in a *dilute* solution of it every day they are used. This wash need not be stronger than half strength of common ash leach lye—say two ounces crude potash, or four of carbonate, per

gallon. The writer has used it about a grape-press and cellar for years, during all of which time no whiff of vinegar ever became perceptible.

Whenever a barrel is emptied, whichever method of manufacture is employed, it should at once be thoroughly washed with hot water, if practicable, rinsed with cold, then lightly sulphurized, bunged closely and put away till required for use. If then required for fermentation of new cider, it must first be carefully and thoroughly washed to remove all traces of the sulphurous acid (sulphur fumes), which would have a tendency to prevent fermentation. Otherwise than that use, a light cold rinse will fit it for any other.

Sulphur fumes, although out of place in wine or cider made in the best method, are yet very useful about all apartments and premises used for making, manipulating, or storing those beverages. They sterilize the atmosphere of the room from all living germs, so that when barrels are opened for inspection, or racked off, they are not liable to become impregnated by the germs in the air and resume action. They destroy, also, all odors arising from mildew and decay. It is a good thing, therefore, to burn sulphur occasionally in all apartments used for these purposes, especially in cellars when first occupied and cleaned. They should also be kept well whitewashed, a new coat of which should be applied to fermenting-rooms every month, and to other apartments two or three times annually. The fermenting-room requires the more frequent application on account of the formation of carbonic acid, which sometimes accumulates in very close rooms sufficiently to render them dangerous. This gas will be taken up by whitewash and rendered harmless.

A cellar or other apartment may be sulphurized by piling three or four ounces on a brick, setting fire to it, closing up all the doors and windows, and stuffing the

cracks with rags. This should be done the last thing at night and the brick should be placed in a pan of water to prevent accident.

Shipping or transportation of cider is always attended with more or less risk and danger at all seasons, but more especially in hot weather. It should always be prepared for by a fresh racking into a clean, carefully-coopered and well-sulphurized barrel, the hoops well-driven home. In hot weather the barrel should be made as cool as possible by any available means—a piece of ice laid on the top for ten hours previous is a good precaution, and it should at no time be exposed to the direct rays of the sun.

STORAGE.

Storage rooms or cellars, as will be seen from what has been said, must be clean, cool, quiet—free from dampness and foul odors. The nearer the temperature can be maintained at 52° F. the better. It should not be allowed to go above 60° F. nor below 40° F.

FREEZING. Very little cider will freeze, unless more than 5° or 6° below freezing point (32° F.)—that is, unless it touches lower than 27° or 26° F. Whenever it does freeze, it is only the water that congeals; that next the wood first solidifies and drives all the spirit to the center. Whenever this occurs the fluid portion within should be withdrawn before the frozen part thaws. Such fluid portion will contain all the alcohol of the whole, and can be distributed among other barrels with benefit to them, or can be reserved for long-keeping in bottles, for which it is well adapted. Thawing of the frozen part to mingle again with the unfrozen will fail to restore the cider to as good condition as previous to freezing. It is therefore to be avoided, or to be allowed only as a purposely-applied means of concentration.

BOTTLING FOR EFFERVESCENCE. Sparkling cider is easily made, if perfect limpidity like champague is not insisted upon. To obtain that the same long tedious process would be required that is employed for that wine. It is not necessary to go into details of that process here. It consists, in the main, of the following items:

First, the wine is made a still wine, much like good cider; second, a large number of barrels are poured together in a huge vat called a *cure*, and is there sweetened by addition of rock candy or refined sugar, at a rate of four ounces per gallon; third, the sugared wine is drawn off into bottles, corked, wired, and put into a fermenting temperature, where they are shaken every day and gradually brought into standing position, tops down, so that the sediment resulting from the fermentation settles upon the cork; fourth, the corks are permitted to fly out and the sediment is removed; then a "dosage" of syrup, brandy, and flavoring is added, and new corks driven in; fifth, the bottles are labeled, foiled, and packed.

This process commences in March or April following the vintage, and takes from three to six months to complete.

The amount of sediment removed from each bottle is insignificant, and if allowed to remain in cider would do no harm, especially if a little pains is taken not to disturb it in uncorking and pouring.

Good bottled cider (effervescent) may be made without removing the sediment of the bottle fermentation, comparatively easy. It is only necessary to add the rock candy or loaf sugar to the whole quantity to be bottled, and then to draw it into the bottles, cork and wire, and store away in a cool cellar. It is necessary, however, that the cider for this purpose should be specially made. Our directions for making still cider have

for the main object of the Pasteurization, as well as the sulphurization, the devitalizing or killing of the remaining ferment. If this has been successfully accomplished the sweetened cider would contain no ferment and would fail to enter into fermentation, but remain simply a sweetened still cider. It is necessary to use for this purpose a cider which has neither been Pasteurized nor sulphurized, or but very lightly sulphurized. It will then contain living ferment, which, with proper temperature, will at once begin to act on the sugar introduced.

Cider suited to this purpose may be prepared late in the season, when the weather is cold enough to check fermentation without either Pasteurizing or sulphurizing, by exposure to the cold as soon as the fermentation has reached dryness. Wine having double the strength of cider stops fermenting at exhaustion of the saccharines in ordinary temperature. Cider having less alcohol and more ferment is more liable to go too far. Once the fermentation is stopped and the cider clarified or filtered, it must still be kept cool enough to prevent fermentation from resuming until it has acquired or developed its flavor and bouquet. This will take, ordinarily, about six weeks. It may then be sweetened, bottled, and brought into low fermenting temperature.

The amount of sugar to be used should be about four to five ounces per gallon, the whole of which will not be fermented, but a portion will remain as sweetness, to counterbalance the increased tartness coming from the carbonic acid. During this bottle-fermenting process sudden accessions of temperature must be guarded against, and counteracted by cooling, otherwise many bottles will burst.

There is a better method of bottling cider, which produces a purer article, free from that excess of alcohol resulting from bottle fermentation, as well as free from living ferment. That method is by charging the cider

with gas, by the same method and apparatus that is employed in preparing bottled "soda water." It involves the use of a special and expensive apparatus, and is applicable to ciders, either Pasteurized or sulphurized. They are simply charged with gas, which is forced into the cider mechanically. There is nothing very special in the preparation of the cider. Of course it is to be presumed that this method will only be adopted by those engaged in cider production or trade in the large way, or by those engaged in bottling other beverages, and who have apparatus suited, since the cost of apparatus precludes a small business.

It is necessary that the apparatus for this purpose—those portions of it, at least, with which the cider comes in contact—be either of material which can not affect the purity and wholesomeness of the cider, or that all the surfaces where such contact occurs should be protected in a way to prevent harmful action. Generally the gas is forced into the liquid in a strong iron or copper vessel, sometimes called either a fountain or a cylinder. Those of American construction are provided with a separate lining of sheet block-tin, while those of English and French make are only "tinned" inside—that is, coated with tin, the same as ordinary tin-plate. Such coating is insufficient for proper protection. The sheet block-tin lining, so long as sound and stanch, affords perfect protection from contact with the shell of copper or iron. But the acids of wine and cider attack tin, and those beverages become impregnated in a very minute degree with the salts of tin. The case is different from that of tin measures, faucets, funnels, etc., commonly used for the manipulations attending the sales of wine and cider. There the contact is usually very brief, is not under pressure, and the action is not hastened by the carbonic acid. There is, therefore, a gradual solution of the tin lining with the formation of tin salts

which are taken up by the cider or wine and impair its perfect purity, if not its healthfulness.

There are two ways of meeting this difficulty. One by plating the interior of the tin linings, and all other surfaces of contact, with silver, which, though effective, is costly; and the other is by constructing the cylinders or fountains of wood strongly hooped and bound with iron. The latter method avoids metallic contact altogether, and has everything to commend it. It is coming very largely into use in England for bottling beer for export, as well as for sparkling wines and even the best grades of carbonated water (soda water).

Whatever style of apparatus is used, cider, as well as wine, must always receive certain preparation before being bottled. It must be slightly sweetened, to balance and tone down the additional tartness imparted by the carbonic acid, and it must be filtered and Pasteurized to prevent introduction of live ferment germs into the bottles, which would be certain to set up a new fermentation, and perhaps burst the bottles. With the sweetening it is also usual to add to wines both flavoring and bouquet. All these being matters of taste, and kept as trade secrets, must be left to the skill and judgment of those engaged, with only this one rule to be observed: Flavor and bouquet, whatever is used, must never be allowed to dominate over the natural taste and fragrance of the cider; they are to be used to heighten and exalt the better qualities of the wine or cider, but never to the extent of masking them. Cider made with special reference to bottling is said to be sometimes flavored by addition of a few quinces in the grinding.

INDEX.

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